

ELECTRICAL CONSTRUCTION AND MAINTENANCE

With which is consolidated *Electrical Contracting*,
The Electricist and Electrical Record...Established 1901

A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and meter shops, covering engineering installations, machines, maintenance and management, in the field of electrical construction and maintenance.

May • 1948

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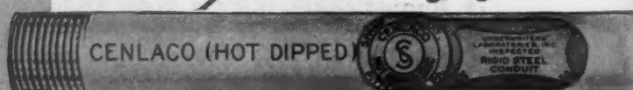
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MAY, 1948

SERVICE IS THE KEYNOTE

INDUSTRIAL MOTOR SERVICE has a character and know-how all its own. The work is complex and highly technical. It takes skillful organization to bring together the parts, materials and specialized skills required to rewind, repair and service electrical apparatus. It takes smart management to give the operation stability, profit and sound business health. But most of all it takes a keen appreciation of effective customer service.

IN PITTSBURGH last month, the national organization of the electric motor shops, the National Industrial Service Association, conducted their annual meeting. In size, scope and evidence of forward thinking, the meeting indicated that industrial electrical service is an expanding branch of the electrical industry, growing in technology, business stature and responsibility.

MEMBERS TAKE PRIDE in a liberal exchange of methods and techniques. Their convention program and association activities are heavily weighted on the side of practical know-how. Behind it is the wisdom of keen businessmen who seek the advancement of the whole motor shop industry as a thoroughly realistic and practical objective.

THE INDUSTRIAL electrical service firm is in a unique market. Its opportunities are growing with electrification. But it enjoys no clear field unimpeded by competition. On the threshold of every market opportunity other organizations are ready and willing to take potential business. But the well organized shop always has a distinct advantage in its service function. It is in a position to perform not only the individual sale or repair, but to deliver a continuing service geared to customer requirements.

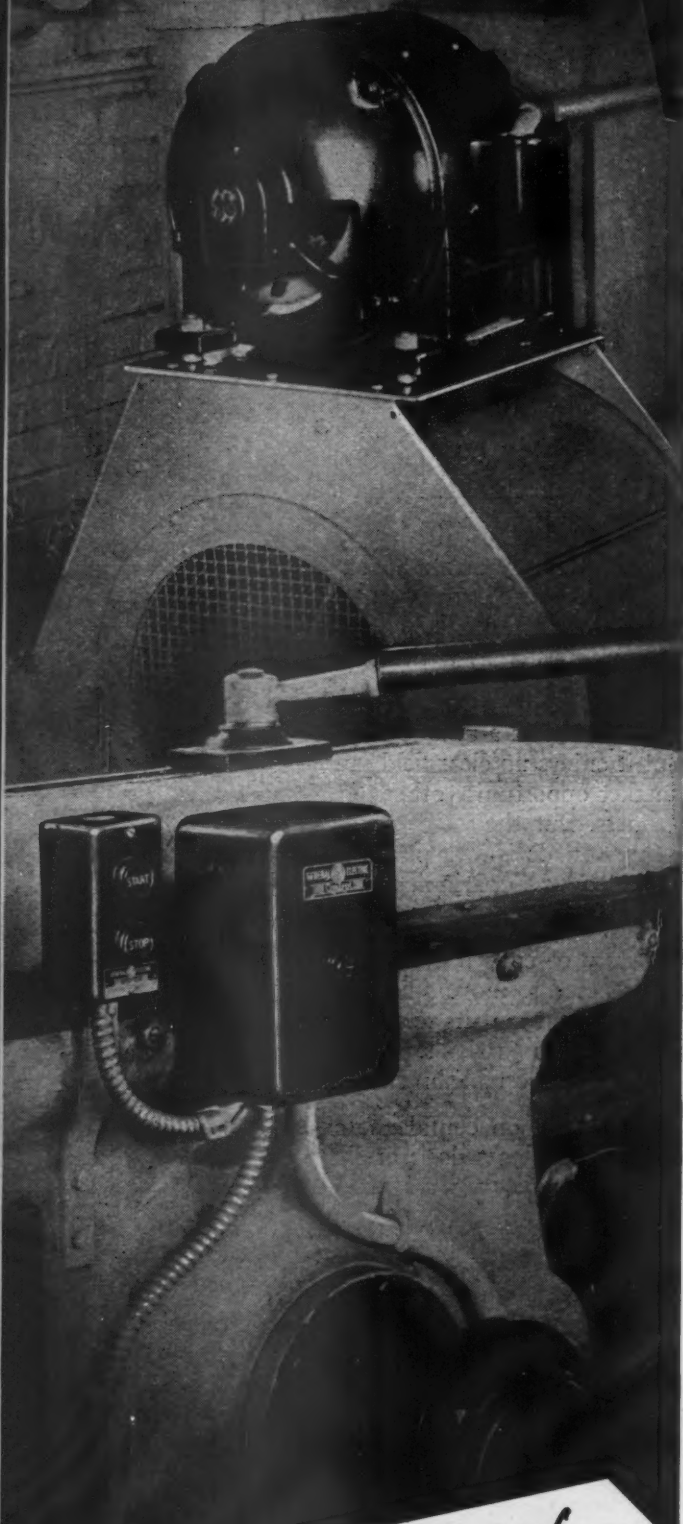
MANY SHOPS carry a complete history of every installation or repair of a customer's equipment. They are not only prepared to move quickly and effectively but with thorough understanding of the equipment and its related production functions. It is common for an industrial service organization's personnel to be part of the "family" in most factories and commercial establishments.

SUCH CLOSE RELATIONSHIPS are built on confidence and ability. They are not earned quickly. They do not thrive on clever deals or sharp bargains. It is not by accident that successful motor shop operators are men of strong responsibility and recognized integrity in their communities, and that their organizations are made up of men of like qualities.

AGAINST SUCH A BACKGROUND policies like "service is the keynote of our business" and "our methods and practices are always available to help the industry" are anything but sophistries. They are hard boiled operating principles designed to enhance the environment, to build the reputation and stature of industrial electrical service as a vital, efficient part of industrial production and commercial effort. In such a business environment, straight forward service combined with modern methods inevitably prospers.

Wm. J. Stuart

ELECTRICAL CONSTRUCTION AND MAINTENANCE



You get the best of
everything electrical
Via Graybar

POWER

TO PLEASE YOUR CUSTOMERS!

Motors by G. E.

Whether your customers need 5-hp motors or 1/100-hp motors, Graybar can provide the best one for each job. We distribute G-E motors, of which there are more in use than any other kind. That's because—AC or DC, general- or special-purpose—they deliver the desired power smoothly and steadily. G-E "Tri-Clad" motors have extra protection against physical damage, electrical breakdown, and operating wear.

Magic Controls

Yes, they work almost like magic! There are proper G-E controls, distributed by Graybar, for making any motor obey your customer's bidding. Even the smallest hand starter has a toggle that flips to mid-position, automatically shutting off the motor in case of overload. Magnetic starters, for remote or automatic control, are available in a range of types. Electronic "wizards" such as the Amplidyne can be supplied for special needs.

POWER SPECIALISTS

At principal Graybar locations, there are Power Apparatus Specialists who will gladly help you select and apply the most suitable motors and controls for specific tasks. The nearest Specialist can help you, too, in planning the best use of transformers, switchgear, circuit breakers, capacitors, and other equipment for intra-plant power distribution.

Local Deliveries

Many motors and a range of controls are now available from stocks at Graybar warehouses throughout the nation. Your near-by Graybar Representative can supply full information about them—as well as myriad items for lighting, wiring, communication, and ventilation; also electrical contractors' tools. Graybar Electric Company, Inc. Executive offices: Graybar Building, New York 17, N. Y. 4842

IN OVER 100 PRINCIPAL CITIES



Recessed fluorescent units illuminate immaculate air conditioned machine shop where precision equipment is made. Similar lighting is used in the enclosed grinding room in the background and adjacent instrument rooms.

Petroleum Research Wiring

Unique electrical design guards sensitive instrument circuits from magnetic disturbances; provides emergency shut-off of building services at Shell Oil Company's new geophysical laboratory.

IN more than 100 working areas of Shell Oil Company's new ultra-modern geophysical laboratory at Houston, Texas, petroleum scientists are engaged in exploration and production research. Their task is made easier by unique features incorporated in the 44,000 sq. ft., two-story, air conditioned, welded steel structure designed and built by the Southwest District of the Austin Company with offices in Houston, Texas.

To meet the demands of flexibility, efficiency and safety, Austin and Shell engineers designed an electrical system tailored to the specific requirements of geophysical research. Installation was made by the Howard P. Foley Company, electrical contractors of Washington, D. C. Outstanding features in-

By August Eckel

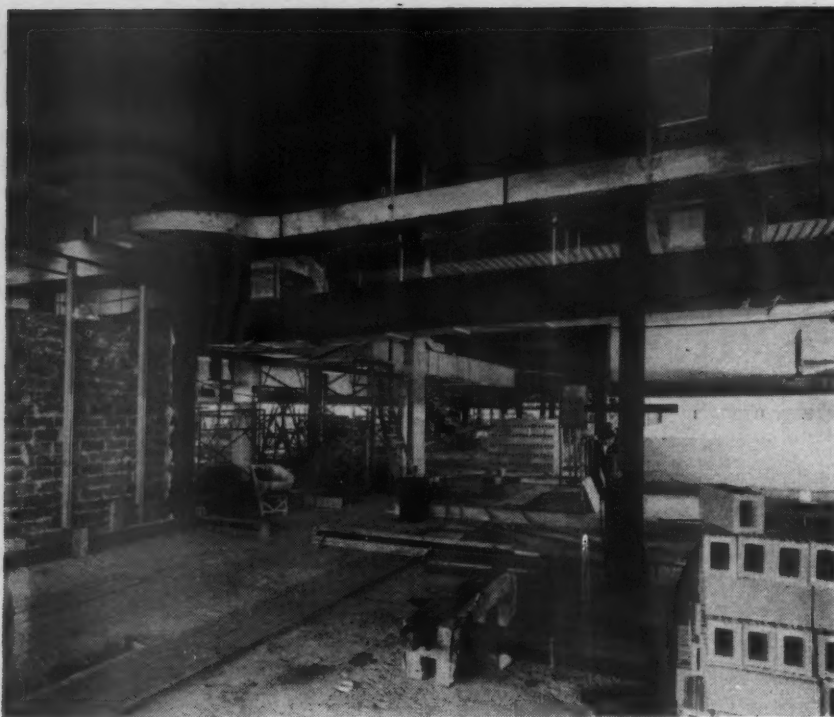
clude concentric cable distribution, one of the few applications to a commercial building, and an emergency pushbutton control system that shuts off all services to the laboratories.

Electrical service is provided by a Houston Power & Light Company 11 kv. line through a 600 kva., 11,000/480-volt, three-phase transformer. From this secondary bus, two underground feeders serve the new laboratory. One is a 440-volt, three-phase, power feeder (3-750MCM cables) for the building service control center (motors for air conditioning, pumps, fans, etc.). The laboratory power and light feeder (6-750MCM and one 4/0 cables) pro-

vides three-phase, four-wire service—through a bank of three 100 kva., 480/120/208-volt, single-phase transformers—for a second control center. Both cubicles are located in a third-floor equipment room.

System Flexibility

In general, 440-volt, 3-phase power is distributed by branch circuits direct from the cubicle to the motors. Circuit wiring is run in the cells of the steel Q-floor construction. Most of the units are remote controlled from pushbutton stations in the air conditioning and boiler rooms. The 240-ton capacity air conditioning system is designed for 24-hour, 365-day per year operation. Some of the equipment is operated by



Construction view of second floor area showing maze of ducts and pipes to supply laboratory services. Note corridor power panel in background and electric cable header over Q-floor cells in left foreground.

momentary contact pushbuttons and others by maintaining contact controls. To prevent restarting immediately after an outage is cleared, a special power-failure relay was added to this 440-volt circuit.

The 3-phase, 4-wire distribution system is the radial type. Eight lighting panels, each with an individual feeder from the power and lighting control center, serve the complete building lighting system. Provision is made for two additional future panels.

Each laboratory in the building has a separate power panel providing service at 120-volts, single-phase; 208-volts, single-phase; and 120/208-volts, 3-phase, 4-wire. Each panel has one 50-ampere, 3-pole and four 30-ampere, 2-pole breakers, and is energized through a separate breaker in main power distribution cabinets strategically located in building corridors. All panels have adequate space for future circuits; are served by feeders having capacity sufficient to carry present connected loads plus anticipated future requirements. All corridor power panels have a built-in pushbutton connected to an emergency shut-off control system to be discussed later.

Laboratory power panels are mounted flush in the glazed-tile columns which are furred out to conceal all electrical and other laboratory service piping. Where no panels were installed, a covered opening was provided

for future use. This, plus the spare circuit capacity in the corridor cabinets, makes electrical system expansion a simple matter.

The flexibility of this design has already proved itself. A short while after the building was occupied, a 15 kva. load was shifted from one location to a point considerably removed and an additional power load, not originally contemplated, was added without undue inconvenience and burden on the owner or the electrical system.

Low-X Distribution

A unique consideration entered the electrical system design. The type of research done in this building requires highly sensitive electrical instruments and signal circuits. Maximum reduction of possible electrical interference with this system was required for reasons of efficiency.

Three factors influenced distribution design: (1) Inductive susceptibility of the signal system; (2) inductive coupling between it and the power system; and (3) the inductive influence of the latter. Since interference effects are proportional to the product of the three, a reduction in either of the factors produces a corresponding reduction in signal system interference.

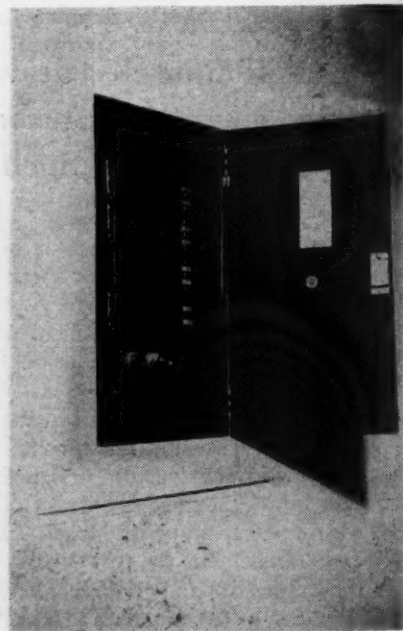
Since inductance in a polyphase distribution system decreases as the spacing between conductors is decreased,

the absolute minimum is theoretically reached in a concentric cable. Thus it was used for heavy electrical distribution within the building.

The two underground service feeders previously mentioned terminated in a manhole outside the laboratory structure. Here they were spliced to a 4-conductor, varnished-cambric, lead-covered concentric cable with the outer copper layer serving as the neutral. Single-conductor to concentric connections were made with special taps. All manhole taps were made in a cast iron box that was gasketed and filled with insulating compound. The main 500-MCM concentric cable runs into the building where it was pulled in fibre duct and conduit raceways up to the main distribution cubicles on the third floor.

To tie in with the main circuit breaker in each control center, the transformation from concentric to single conductor was again made. Except for the compound box (not necessary inside) a splice similar to that in the manhole was made inside the cubicle.

Wherever practicable, concentric cables (with synthetic jackets) in sizes ranging from No. 2 to No. 2/0 were used as main feeders from the third-floor control centers to light and power panels. In all other cases, and for branch circuits, twisted cable of two, three and four conductors (minimum of two twists per lineal foot) was used.



Typical corridor power distribution panel that feeds a group of individual laboratory panels. Note pushbutton at bottom for emergency shut-off system. The red "off" button projects through door cover.

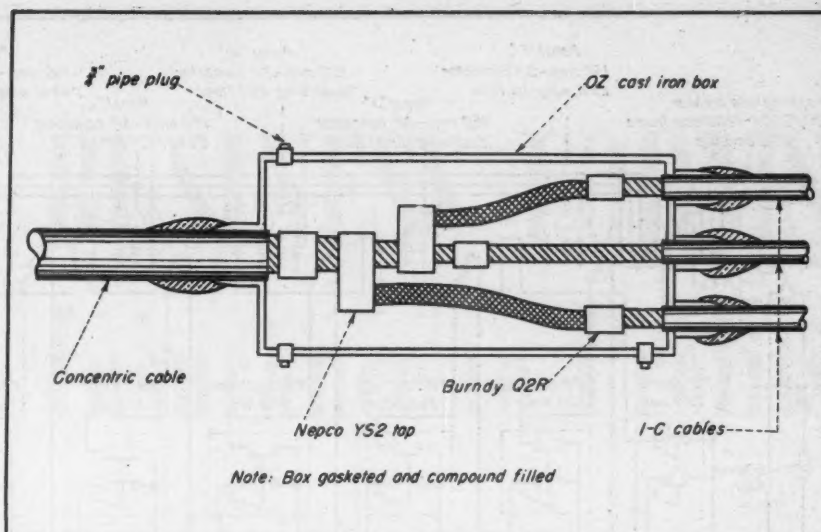
When making the concentric to single conductor taps, special care had to be exercised to prevent crushing the insulation between the concentric conductors. Adequate and proper moisture seals were also important.

The signal system that necessitated this "protection" from inductive disturbances originates in a main signal generator room and embodies a raceway system that provides outlets in all laboratories, at several points on the building exterior and on the roof. Additional precautions were taken by maintaining specific clearances on runs paralleling and crossing light and power circuits.

Emergency Shut-Off System

Normal hazards of petroleum laboratory operations have been offset by unusual safety precautions. In addition to shatterproof safety glass interior partitions and doors and self-starting safety showers, a pushbutton emergency shut-off and alarm system controls all building services.

Should a technician get into trouble because of explosion or fire, he can reach an emergency shut-off station within 25 feet of any laboratory. Operation of one of these large red, easily spotted, buttons cuts off the laboratory power, gas, compressed air, vacuum, steam and hot water to that particular



Details of the manhole splice between the single conductor underground service feeders and the concentric cable run into the building. Outer duct of the concentric cable is the neutral conductor.

wing of the building; interrupts the main 440-volt power supply to shut down the air conditioning system; flashes a red light at the telephone operator's station and sets off a howler in the corridor serving the affected wing. This howler can be silenced by a local switch.

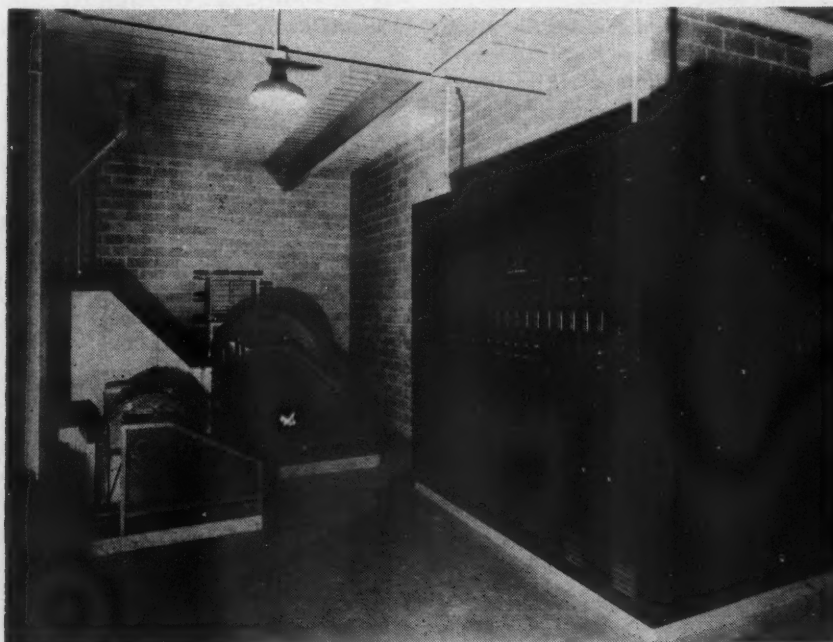
To prevent possible error, the emergency control button projects through the door of the corridor panel or control station. It is the only button avail-

able to push. To reset the system, the panel or control cabinet door must be opened to gain access to the black reset button adjacent to the "off" button.

The 24-volt direct current control circuit is operated by a storage battery connected to the 120/208-volt bus through a battery charger. As indicated by the attendant circuit diagram, operation of the emergency button opens the main circuit breaker feeding that corridor panel; opens the 440-volt



Closeup of concentric feeder cable terminal in main 440-volt breaker cubicle of power switchboard. Single cable jumpers were tapped to concentric conductors by parallel and straight-through connectors.



Main switchboard for all laboratory electric service is in third-floor equipment room. Cubicles at left are for the 440-volt, 3-phase power system; extension at right for the 120/208-volt, 3-phase, 4-wire laboratory service. Fans in background exhaust air from chemical research laboratories and cafeteria direct to the outdoors. Main electric service is from a 600 kva., 11,000/480-volt three-phase transformer.

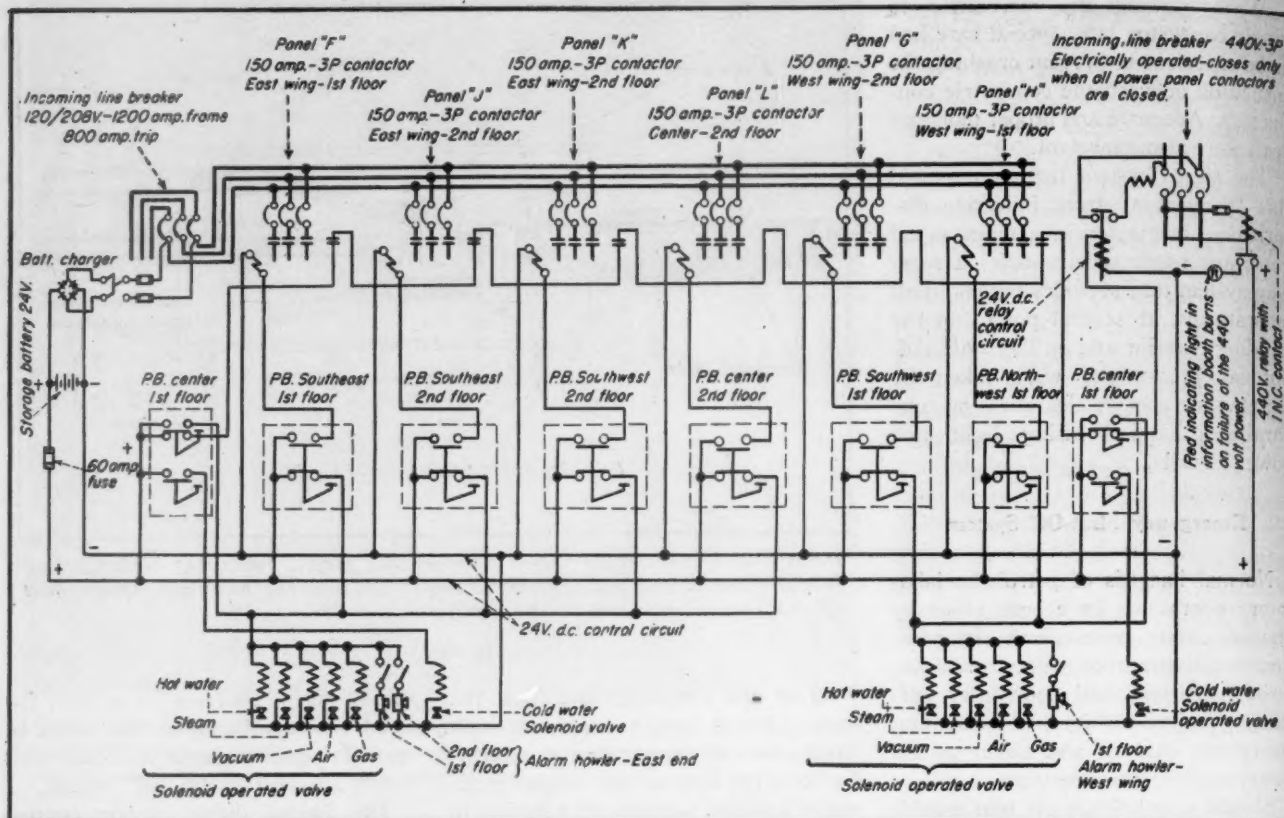


Diagram of the 24-volt direct current control circuit for the emergency shut-off system. All corridor power panels, building service control valves and 440-volt power system (air conditioning) are affected.

incoming line breaker; closes the solenoid valves on the various building service systems. The 440-volt breaker must be reset manually.

Lighting Facilities

In addition to the 17 three-room laboratory suites and several general laboratories, there are a large machine shop, a glass blowing department, a panelled library, a conference room with movie projection facilities, a cafeteria with modern kitchen, five individual dark rooms plus a large central photographic and reproduction department. All areas contain the latest lighting equipment.

Illumination intensities of better than 50 footcandles maintained are provided in the various laboratories, machine shop, offices and library by recessed two-lamp Miller fluorescent fixtures with 3500° white lamps. Where continuous troffers were installed they were mounted on 5-foot centers. In other areas, rectangular, square and individual fixture patterns were used. Eggcrate louvers were installed in the work areas; diffusing glass in the library and the executive suites which also has continuous cold cathode cove lighting. Thus, intensities are max-

imum in functional areas while glare is minimized in areas involving paper work.

Decorative, yet functional, lighting was installed in the combination cafeteria and auditorium (serving area can

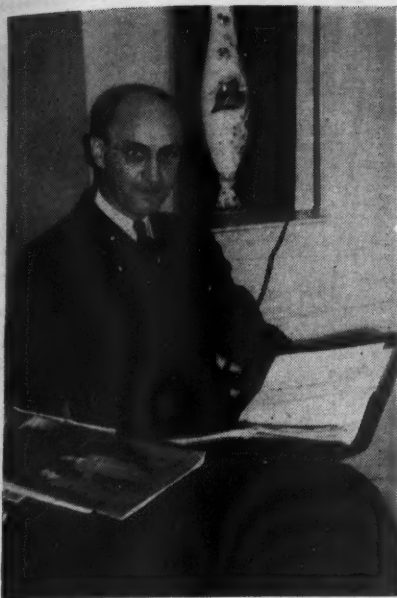
be concealed by lowering an overhead door). Continuous cold cathode tubing (12,000 volts) is concealed in the large cove around the room as well as in drum-shaped center fixtures. Column pilasters of corrugated structural glass panels are illuminated from within by incandescent lamp reflectors mounted in the base of the column. Metal acoustic tile ceilings were installed in all areas except the chemistry section where cement asbestos perforated tile was used. Walls and tile in the work areas are of a light color to improve lighting efficiency.

A coffered ceiling effect is produced in the entrance lobby by the ingenious use of aluminum I-beams and inverted extruded aluminum cold cathode lighting troughs. A series of 4-inch beams set crosswise (at about 4-foot intervals) in the ceiling coffer supports four rows of 20 millimeter, 3500° white, cold cathode tubing (100 milliamps, 12,000 volts) in the inverted aluminum troughs. The resulting lighting effect is most pleasing.

Also part of the complete electrical installation were such conventional items as electrostatic air cleaning; intercommunicating telephone system and a central office fire alarm and watchman system.



Typical power panel installation in a laboratory service column. Note other laboratory service lines under table. Exhaust grille at bottom vents air from laboratory, ventilates column and ceiling spaces.



Business man and secretary of the Midwest Electrical Council, Wm. A. Ritt fathered the development of the Council business form service for electrical contractors and dealers.

BUSINESS FORMS

Insurance to Profits

Well planned business forms and systematic records are a valuable asset. Here's how a Minnesota contractor organization helped its members and their industry to operate on a sound business basis

SOME ten years ago the Minnesota Electrical Council (now the Midwest Electrical Council), under the leadership of its secretary-manager Wm. A. Ritt, developed a portfolio of standard accounting forms for members of the organization. That service now has grown to include a wide range of bookkeeping equipment tailored to the contractor's specific type of business operation.

Extending the range of this service, the material was made available to all contractors in the area. Council members, however, are accorded a modest discount. Even so, prices are maintained at a level just sufficient to carry the cost of handling. And, the benefits are passed on to non-members on the far-sighted policy that better records make better business men and more intelligent competition.

To date, over 500 contractors have bought complete or partial systems from the Council. Many others have had the benefit of expert assistance from headquarters on their bookkeeping problems.

Checking over the bookkeeping methods of successful members of the Council, Ritt and his committee settled upon a line of standard bookkeeping systems. Although simple enough for the small concern, it is flexible enough for use by many larger electrical contracting firms.

The Council offices took over the

agency for this system and are retailing the books and filler sheets to the members. Full operating details are supplied with all the equipment. And each item has been designed, on the basis of practical experience, to provide good records.

The simpler type, recommended by the Council for small electrical contracting shops, consists of a daily cash and sales record plus a simplified bookkeeping and income tax record. For a medium sized shop, this system is further expanded by a more elaborate ledger. For the larger shops, the Coun-

cil makes available complete 24-column cash journals and ledger sets. Of course, any good business concern has invoice and purchase order forms of its own.

But, in electrical contracting there are estimates to be prepared, proposals to be submitted, contracts to be signed. On the job and in the shop there are material lists, time cards, service orders, and extra work orders that must be recorded in some methodical way. Properly organized printed forms are necessary if this paper work is to be done efficiently.

WHY BUSINESS FORMS PAY

- 1. Estimating forms reduce errors.**
- 2. Work orders and job tickets insure prompt service—stop complaints.**
- 3. Cost records detect profit leaks, simplify reports for tax purposes.**
- 4. Proposal and contract forms help to sell by establishing a definite work proposal, bid and contract agreement.**
- 5. Time sheets stop lost time, provide check against estimated job labor.**
- 6. Payroll records insure against unjust claims, provide data for various labor and social security reports.**
- 7. Job records provide useful customer data and complete job case histories.**

HOUSE WIRING SPECIFICATIONS & PROPOSAL

No. _____

Submitted By _____ Electrical Contractor	To _____ Wiring to be
--	-----------------------------

The undersigned hereby agrees to wire the premises named above from _____
complete the electrical work as specified herein for _____

KEEP YOUR ELECTRICAL WIRING INSTALLATION SAFE!

premises was installed (or remodelled) _____

bonded by the State of Minnesota _____

Phone No. _____

ired by law stating that minimum legal re-
the Laws of 1937 have been complied with,
work done by this contractor

PERMIT NO. _____

NAME _____
JOB AT _____ FINISH _____
START _____

JOB SHEET

JOB NO. _____

MATERIAL & PRICE SHEET

MATERIAL & PRICE SHEET												JOB		DATE			
CONDUITS			1/2 Inch			3/4 Inch			1 Inch			1 1/4 Inch			1 1/2 Inch		
AND FITTINGS			Quan.	Each	Total	Quan.	Each	Total	Quan.	Each	Total	Quan.	Each	Total	Quan.	Each	Total
Conduit Rigid																	
WORK																	
193																	

ORDER TO DO EXTRA WORK

Date _____ 193____
To _____ Electrical Contractor
You are hereby authorized to install the following:

Customer's
Order No. _____

WORK ORDER

Date _____ 194____

Ordered By _____

Position _____

To Power Company, Municipal Plant, or to other persons, group, or corporation supplying electrical current.

STATE OF MINNESOTA }
COUNTY OF _____ } SS

Affidavit Re: Electric Wiring

As required by Chapter 325 Minnesota Laws of 1947, in lieu of Inspection Certificate
from a recognized inspection department or officer, where inspection is not available.

(Name of Person
Who Certifies)
HEREBY CERTIFIES that the Electrical Wiring and Equipment described below . . .

(Check One) ☐ was installed by me as a licensed and bonded Master Electrician
☐ was installed under my supervision by licensed electrician(s)
☐ was installed by me as the owner of the property

on the premises of (Owner or Lessee) _____ First Name _____ Middle Name or Initial _____
located at (*Address) _____ Section _____ Township _____
City, Town or Village of _____ County _____
and equipment installation covered by this affidavit consisting of (**Description see also reverse

was done so as to comply and does comply with all of the requirements and regulations set forth in C
It wired by Electrical _____ Minnesota Master Electrician's License No. _____

LOCATION OF JOB _____

CAUTION

All Oil Has Been Drained From Bearings
BEFORE STARTING FILL OIL WELLS
WITH A GOOD GRADE OF MACHINE OIL. These Bearings
are the ring oiler type and the wells must be filled to the bearing
point or if no overflow is provided fill with sufficient
the lower part of the rings so then
with oil when they run.

A few of the concise, streamlined business forms prepared by the Midwest Electrical Council to simplify

STANDARD MINNESOTA FORMS

- | | |
|-------------------------------------|---|
| House wiring proposal | Service order |
| Farm wiring proposal | Extra work order |
| General wiring proposal | Shop-work order |
| Wiring affidavit | Sales slips |
| Estimating—3 forms | Returned goods invoice |
| Job sheet and cost record | Customer order agreement |
| Material list and price sheet | Payroll record |
| Material and tool requisition forms | Safety warning card |
| Material returned from job | Conditional Sales Contract |
| Repair tag and claim check | Collection form to go with Council collection service for members |
| Daily time cards | |

The Council made a careful study of available printed forms, many individual forms prepared by contractors, and worked out a series of standard accounting forms which fit the average electrical contracting business and can be printed in large quantities at low price for general distribution. This work was consolidated into a group of 20 account forms, streamlined, simplified and printed in economical quantities.

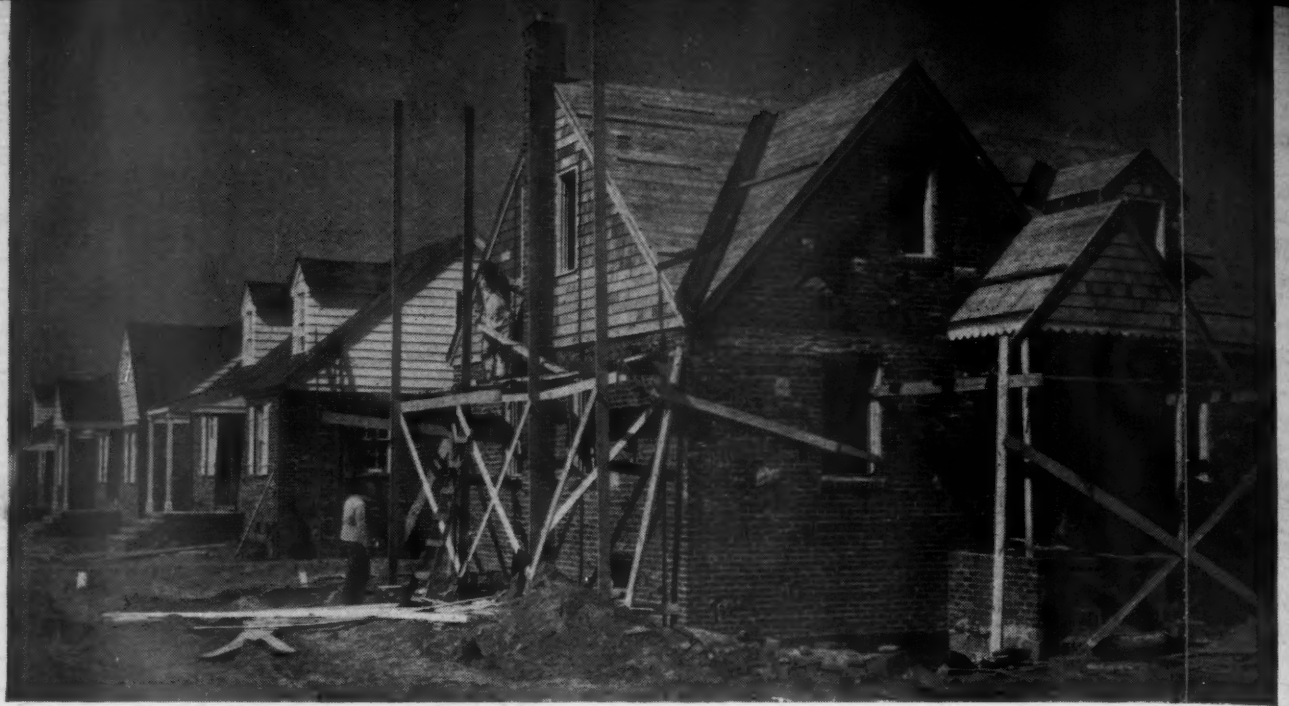
Most of the members purchase their forms through the council offices. More than 300 non-members use this service. To date about four and one-half million forms have been sold and last year's sales approximated \$7,500.

A sound, standard proposal and contract form for house wiring is an expensive job for the individual contractor to prepare and print in the quantities he could use. The Council orders a simple, legally satisfactory

DATE _____

The Electric Shop
Electric Wiring • Appliances • Repairs

71



RESIDENTIAL WIRING

Residential wiring standards follow advancing electrical utilization. Wiring costs reflect both recent economic changes and growing system requirements. In the following pages both trends are analyzed in detail.

COST is the most critical factor in modern residential wiring. Every house wiring job must eventually meet the customer's appraisal of its worth. Builders must find wiring a salable feature or reduce it to minimum essentials. The home buyer must recognize its value in relation to other building features. The loan agencies must understand its worth as a prudent property investment. The architect must measure the cost of wiring against its contribution to the usefulness, beauty and convenience of the structure as a place to live.

Wiring, however, plays only a secondary role in these considerations. The things which people want are the aids, conveniences and comforts of light, heat, power and entertainment which can be had by means of appliances, lighting equipment and other electrical devices. Nobody wants electricity, they want the many things that electricity can do for them. Nobody wants wiring, but they do want, and expect, all the services and conveniences that they can have only through a well engineered wiring system.

During the war years and since, wiring costs have followed the same course as most other products and services. Labor, materials, job expenses and every other part of the contractor's cost environment have risen steadily. On a unit basis costs have more than doubled since the pre-war years. Outlet for outlet the contractor must get $2\frac{1}{2}$ times the price for a given job in 1948 as he did in 1938 to stay even.

It is important to recognize this change for what it is, a result of inflation. The change has occurred in the value of the dollar, not in wiring. The tremendous pressure from government, the press, authorities on housing and the like

cannot roll back the price of housing or the price of electric work without rolling back the price of materials, wages, taxes and all the other expenses which contribute to the final price. And we can be certain that these are practically irreversible short of a major depression.

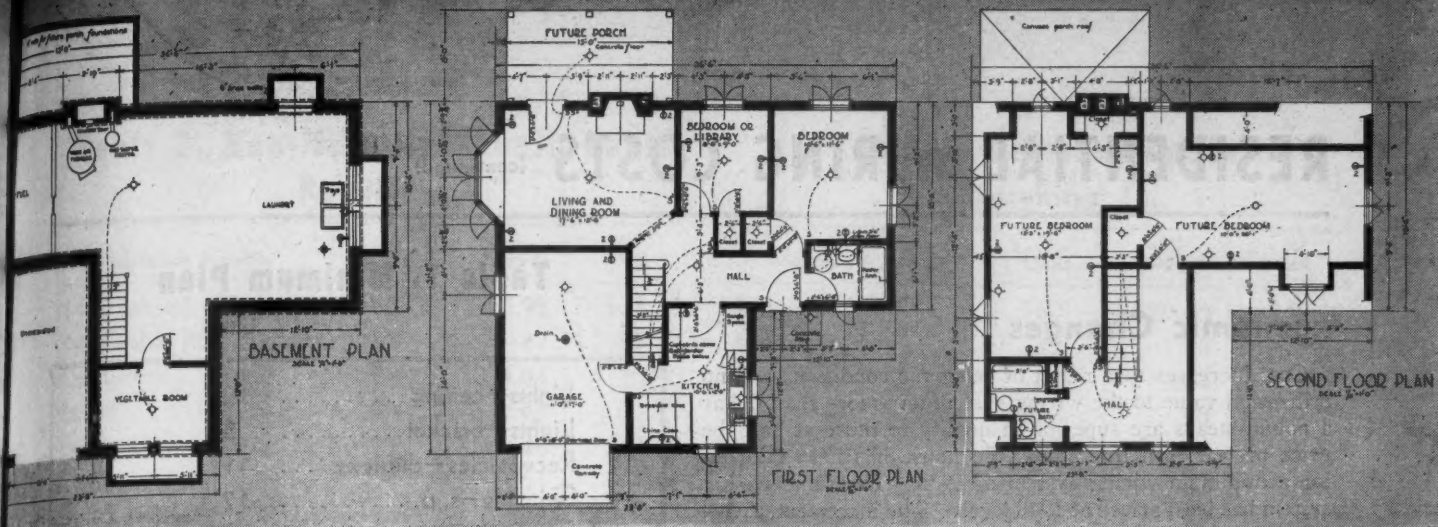
For a practical understanding of wiring values we must begin by discarding traditional appraisals. Each of us has in his memory a mental picture of a \$5000 home or a \$1000 automobile. In the market place these values are no longer realistic. The chief value of our traditional appraisals is to help us find the economic increments that have taken place.

In this study of wiring costs we have made specific comparisons between 1938 and 1948 labor and materials on the same project. The house used is one of modest size, 1583 square feet, consisting of a basement, first floor and second floor. In 1938 it was designed to cost about \$7200. In 1948 it would cost in the order of \$15,000.

The electrical installation in the first group of tables (1-6) is based upon a typical minimum job in 1938. Code changes since would require a few more plug receptacles today and No. 12 instead of No. 14 wire in the appliance circuit. However, since these figures are developed to establish only the comparison of costs as a result of economic changes, the same quantities of materials have been used.

This type of wiring system, it must be emphasized, bears no relation to actual electrical requirements for modern living. It provides for some lights, thinly scattered convenience outlets, a few appliances, the bare necessities of minimum utilization.

The second group of tables covers the increment in cost



Typical home plan used for this analysis. The electrical system indicated was not used. Minimum and adequate wiring systems were developed on the basis of the layout schedules shown on the following pages. Cost comparisons were made for increments over a ten year period as a result of economic and utilization changes.

COSTS

By W. T. Stuart

from a minimum to a moderately well engineered wiring job installed in the same house built today. This job is about at the level established in the Handbook of Interior Wiring Design, but still without provisions for many of the appliances now on the market. Further, there is little provision for any extensive growth in electrical utilization.

The comparison between a minimum utilization installation and one designed around modern loads is of the utmost importance in understanding wiring costs. In house building, volumes and areas largely determine the quantities, and consequently the cost of most construction features. Roofing, painting and foundations are examples. Deviations from minimum requirements are in the direction of superior quality, longer life, greater safety or better appearance. Such quality levels can be readily adjusted to the buyer's preferences and willingness to pay.

In electric wiring the deviations from minimum are quantitative. They represent more outlets, provisions for electric cooking, added conveniences and comforts made possible through more and easier use of electricity. The increment in cost is the result of increased electrical utilization. Such cost increments can not be avoided by lowering quality in the sense of substituting cheaper materials of equivalent function. They can only be avoided by cutting down present and potential electrical utilization.

Is such wiring adequacy really necessary? Isn't a cost rise of two to three times from minimum to adequate pretty steep? Let's look at the record. In 1937 the residential use of electricity totalled 17,691 millions of kilowatt hours. In 1947 it totalled 44,000 millions of kilowatt hours. The increase was almost 250 percent in 10 years. All of this

The purpose of this project is to present clearly and in detail what wiring costs are today, and the values they represent. Definite figures are chosen to cover typical cases. Local costs will vary. For instance, in some communities, all house wiring is done at full union scale, in others the average hourly wage for house wiring, is below scale. This analysis is figured at \$2.70 per hour as an average selling price. However, the relationships shown and the order of values represented will be practically consistent for most urban and suburban areas.

Some wiring costs are closely related to the size of the house, its area and the number of rooms. Other wiring costs bear no such distinct relationship. They depend on the specific loads to be served whether in a cottage or a mansion. So simple percentages of building cost are inadequate for proper appraisal.

The most recent previous era of extensive residential building was the '37 to '41 period. As a result much current house wiring practice is based upon the experience of that time. Housing shortage has suppressed the normal preferences of home buyers. Rising costs have cut into building funds. The result is abnormally low allowances for electrical work.

The following tables show what recent trends, both economic and utilization are doing to wiring costs. Electrical work for the years ahead needs a new basis for appraisal and a permanently higher order of value in the building budget.

energy was used through the facilities of house wiring systems.

The curve of residential electrical utilization shows a constant increase since 1920 with only a slight flattening in 1932. Extending the present curve to 1958 would give a consumption of 70,000 millions of kilowatt hours. Clearly, no such increased utilization can be safely accommodated on wiring systems which provided for only bare essentials 10 years ago. It is evident that residential wiring system design must reflect a realistic appraisal of utilization growth. And this growth must be considered *outside* of the overall pattern of building values. For example, a good roofing specification in 1938 would be essentially as good today. A good wiring specification of 1938 might be quite inadequate today.

It is necessary to appraise present wiring costs in the light of both economic and utilization changes. The ultimate test of the wiring system will be whether it conveniently serves the present and immediate future needs of the house owner. If the cost of such an installation goes beyond accepted wiring cost levels, the accepted levels are wrong. The industry must educate its customers to more realistic standards of house wiring values.

RESIDENTIAL WIRING COSTS (continued)

Economic Changes

Cost increases as a result of economic conditions add no utilization value to the wiring system any more than dollar a pound steaks are superior in quality to those at half the price prewar. In this study, the house has been laid out for a minimum wiring system of 1938. The same wiring system has been priced at 1948 levels. The increment, therefore, is entirely the result of economic differences. No real values have been added.

The layout has been made for three different wiring systems representative of conventional house wiring practice in various communities. To simplify the tabulation the roughing in work, affected by type of wiring system, is given in detail separately for each system. Finishing work, common to all three systems and bell work are shown in separate tables.

The detailed listing of materials for the service entrances are omitted to conserve space since each type involves a listing of 18 or more items. No comparison is shown for electric range and water heater installation. A bare layout of this type would be unlikely to involve such work. However, the relationship would be approximately the same as the service entrance.

The totals for each type of wiring system show cost increments of 109 to 136 percent over 1938 prices. This price increase is the result of the following conditions:

- a) increased material prices
- b) increased labor rates
- c) increased overhead costs
- d) reduced labor efficiency

None of these conditions show evidence of important reverse trends in the immediate future. Greater supplies and increased competition might influence one or more to some extent. New wiring materials and methods, more use of specialized and powered tools, better labor efficiency could influence total prices comparably downward. But these are hopes, not evident trends, and in any case more likely to appear in bigger work than the minimum wiring job analyzed here.

By breaking down the minimum job to its component parts, it becomes clear that wiring costs are at a new level, not only for the overall price but right down to the straps and connectors. And the 1948 totals are for irreducible bare bones wiring that would have been considered minimum ten years ago.

Utilization Changes

If wiring costs were on the increase solely from economic change, it would not be too difficult to readjust the appraisals of builders and buyers to a new level. Other building products and services are passing through a similar phase of price adjustment. Floor coverings, foundations, window frames, hardware, heating, and all the rest have had to follow much the same course.

But wiring is affected by another and far more important trend. Additional facilities, capacity, outlets and conveniences are required by a growing number and variety of appliances, lamps, devices and gadgets that somewhere have to connect to a reasonably stable and convenient source of electricity.

Utilization growth is pushing wiring costs up at a faster

Table 1. Minimum Plan

	Units
Lights—ceiling.....	12
Lights—bracket.....	3
Receptacles—duplex.....	11
Switches—s. p.	12
Switches—3w.....	2
Oil burner connection....	1
Total outlets.....	41
Circuits.....	4
Service.....	30 amp.
Bell—combination.....	1

rate than economic change. There is an important difference, however. Wiring systems designed to permit utilization growth represent appraisable added value. And the added value in terms of comfort and convenience to the owner may be many times the increment over the minimum possible wiring job.

For this study the same floor plan, illustrated on page 73, was laid out for an economical wiring job designed to serve immediate connected loads, the use of the more common home appliances with high efficiency and safety, good lighting and most of the facilities and capacity that the home buyer expects in his wiring system. Also there is sufficient capacity in the service for moderate load increases, probably enough to prevent electrical obsolescence within the first ten years anyway.

The layout schedule gives the number of outlets of each type and the size of panel and service. Three representative wiring systems were selected, non-metallic sheath cable armored cable and electrical metallic tubing. The job was figured for each of these systems.

Wiring is generally conventional. There are no special or unusual features which would not be normal at the present time to a home of this size. The system provides for an electric range, water heater, attic ventilator, kitchen ventilator, electric sink and automatic heating. There are plug receptacles for an ordinary washing machine and iron. No provisions are made for an automatic washer, high wattage ironer or dryer, however adequate service capacity is available.

The material quantities are shown in detail. No fixtures or fixture installation is included. A switch and pilot and an outlet are included for the attic fan but no allowance is made for connection to the fan. A 30 amp. switch is included for the oil burner disconnect but no oil burner wiring connections are included. Appliance outlets in the kitchen, dining area, laundry, and outdoors are on three No. 12 appliance circuits. Range wiring is provided up to and including the range receptacle. Water heater wiring provides for connection to the terminal box.

The question of outlets for attic fans or electric sinks where the equipment is not installed during construction should be considered in the light of probable future use. The same is true of the range and water heater circuits in "gas" territory. Can we safely guarantee to the home owner or

**Table 2. Non-Metallic Sheath Cable
Roughing**

Materials & Labor	Units	Cost 1938	Cost 1948
14-2 cable ft.....	560	\$17.92	\$33.39
14-3 cable ft.....	35	1.87	3.34
Connectors.....	84	5.04	10.40
Straps.....	120	.47	.75
Boxes.....	15	1.44	3.52
Plaster covers.....	11	.63	1.42
Switch boxes.....	25	2.92	8.64
Ceiling box supports....	15	1.83	3.61
Switchbox supports.....	25	2.75	4.97
Misc.....		1.00	2.00
Labor.....		17.00	45.90
Total.....		\$52.87	\$117.94

TABLE 1—Minimum plan allows barely enough outlets to permit minimum utilization, cone lights and a few appliances. Such jobs, sometimes seen today, were inadequate years ago.

TABLE 2—Comparison in cost for roughing in a non-metallic sheath cable job in 1938 and 1948 on the minimum layout. Conventional connectors, boxes and supports are figured.

TABLE 3—Comparison in cost for roughing in an armored cable job on the same floor plan and electrical layout. Other types of boxes will affect the cost by a small percentage

TABLE 4—Using electrical metallic tubing on the same layout, roughing costs are up but the comparison from 1938 to 1948 is of the same order as other roughing methods

TABLE 5—Finish work is substantially the same for all three types of roughing figured. It includes conventional residential type devices in the minimum layout.

TABLE 6—Bells and bell wiring on minimum jobs are a small item but involve the same cost increase as other parts of the electrical work through the past ten years.

Table 5. Finish Work

Materials & Labor	Units	Cost 1938	Cost 1948
Duplex recept. & plates.	11	\$1.93	\$4.19
S. P. switch.....	12	3.52	5.36
3w switch.....	2	.93	1.26
Switch plates.....	14	1.02	1.43
Laundry recept. penda	1	.67	1.40
4 in. recept. cover.....	3	.44	1.08
30 amp. fused switch....	1	1.51	2.23
Misc.....		.50	1.00
Labor.....		7.50	20.25
Total.....		\$18.02	\$38.20

**Table 3. Armored Cable
Roughing**

Materials & Labor	Units	Cost 1938	Cost 1948
14-2 cable ft.....	560	\$20.60	\$48.20
14-3 cable ft.....	35	1.80	4.21
Connectors.....	84	3.64	10.40
Straps.....	120	.20	.75
Outlet boxes.....	15	1.44	3.52
Plaster covers.....	11	.47	1.42
Switch boxes.....	25	2.92	8.64
Ceiling box supports....	15	1.83	3.61
Switch box supports.....	25	2.75	4.97
Misc.....		1.00	2.00
Labor.....		17.00	45.90
Total.....		\$53.65	\$133.62

**Table 4. Electric Metallic Tubing
Roughing**

Materials & Labor	Units	Cost 1938	Cost 1948
½ in. E.M.T. ft.....	570	\$32.31	\$45.60
Couplings.....	40	3.87	6.00
Connectors.....	86	7.00	10.96
Straps.....	60	.13	.32
Outlet boxes.....	16	1.55	3.76
4 in. sq. boxes.....	10	1.11	2.83
Switch boxes.....	14	1.64	4.41
Round plaster covers....	11	.63	1.42
Switch covers 1g.....	9	.60	1.62
Switch covers 2g.....	1	.09	.22
Ceiling box supports....	15	1.83	3.61
Sq. box supports.....	10	1.11	2.40
Switch box supports.....	14	1.53	2.78
14 R. C. wire.....	1400	13.83	25.80
Misc.....		1.00	2.00
Labor.....		34.00	91.80
Total.....		\$102.23	\$205.53

Table 6. Signals

Materials & Labor	Units	Cost 1938	Cost 1948
Bell wire duplex.....	80	\$1.07	\$1.50
Staples.....	20	.08	.20
Push buttons.....	2	.40	.44
Comb. bell & buzzer....	1	1.13	1.22
Transformer.....	1	1.13	2.19
Misc.....		.50	1.00
Labor.....		1.50	4.05
Total.....		\$5.81	\$10.00

RESIDENTIAL WIRING COSTS (continued)

Table 7. Service Entrance

	Cost 1938	Cost 1948
Service 3 No. 8 30 amp. switch fused 4 circuit panel S. E. Ent. cable non-metallic feeders, bare ground, total.....	\$15.80	\$51.84
ASE Ent. cable armored cable feeders, armored ground, total...	18.50	53.73
Rigid conduit service, feeder and ground; total.....	24.10	63.88
Total.....	\$58.40	\$169.45

Service equipment costs vary according to local rules and practices. These are typical cable and conduit service for a minimum job layout to provide a 10 year comparison.

Table 8. Total Wiring Costs

Non-Metallic Sheath Cable	1938	1948
Rough wiring.....	\$52.87	\$117.94
Finishing.....	18.02	38.20
Signals.....	5.81	10.60
Service.....	15.80	51.84
Job expense.....	13.00	22.00
Totals.....	\$105.50	\$240.58

Armored Cable

Rough wiring.....	\$53.65	\$133.62
Finishing.....	18.02	38.20
Signals.....	5.81	10.60
Service.....	18.50	53.73
Job expense.....	13.00	22.00
Totals.....	\$108.98	\$258.15

E. M. T.

Rough wiring.....	\$102.23	\$205.53
Finishing.....	18.02	38.20
Signals.....	5.81	10.60
Service.....	24.10	63.88
Job expense.....	13.00	22.00
Totals.....	\$163.16	\$340.21

Totalling up the minimum job for three types of wiring systems in 1938 and 1948 shows the cost increments in residential wiring due to economic changes.

potential buyer that in the foreseeable future he will not buy or install any of this equipment? If we can, the wiring may be omitted. But the cost of wiring for any of these devices in the original job is only a fraction of what it would cost to install them in a finished house.

Special Features

The layout indicated in table 16 provides for most conventional wiring system requirements in the average house. Special features may be added that provide extra convenience and utility at very little additional cost. Characteristic of the well designed job, outlets and special circuits can be added easily and economically for special purposes.

Many home owners object to large unsightly service entrance conductors extending from the house to the utility line. An underground service is the answer. Table 17 gives the cost of a typical underground service involving a 50 foot run from the house terminating at a pole. Underground cable is used buried 24 inches, protected for 10 feet at the pole by rigid conduit. Its cost may be substituted for the service entrance cost in the summary tables, if underground service is included.

An appliance already popular and destined to be as universal as the medicine cabinet is the built-in bathroom heater. A 1500 watt heater involves a full No. 12 circuit, panel circuit and connections to the heater. Switch and outlet box is usually provided as part of the heater. If no heater is installed during building a blanked outlet may be installed at the appropriate heater location. Table 18 shows the cost details for an armored cable installation.

Where many plug-in devices and appliances must be served along a counter or wall, multiple outlet assemblies in continuous strip provide a neat, convenient and inexpensive method. In tables 19 and 20 two multiple outlet assembly jobs are shown, one involving three 3 foot sections in the kitchen, another involving six foot sections in the living rooms. It should be noted that although these are shown as an additional cost, they replace conventional plug receptacles in the same area. The actual additional cost may be substantially less depending upon the number of outlets omitted. Each of the multiple outlet assembly layouts is served by a full circuit from the panel.

Living room and bed room plug receptacles serve many portable lamps. Duplex plug receptacles are easily split for two feeds, one normally on, the other switched. The additional work consists of replacing the 2 conductor cable with 3 conductor cable and installing the additional switch. The cost as shown in table 21 is \$9.17 for an ordinary living room or bed room.

Modern automatic laundry equipment in a modern laundry plan forms a highly efficient unit operation. It deserves the same kind of wiring approach. Table 22 covers the cost of a special laundry wiring layout with its own feeder and panel. Two multiple outlet assemblies serve the plug-in equipment. A heavy duty plug receptacle is provided for the electric dryer.

Number of rooms and floor area determine the number of plug receptacles, the switching requirements and to some extent the number of lighting outlets. Modern utilization has introduced other, in some instances more compelling, considerations.

As electrical utilization grows, considerations other

Table 9. Non-Metallic Sheath Cable

Roughing

Materials & Labor	Minimum		Adequate	
	Unit	Cost	Unit	Cost
14-2c cable.....	560	\$33.39	510	\$30.40
14-3c cable.....	35	3.34	290	27.70
12-2c cable.....			310	24.87
Connectors.....	84	10.40	226	28.10
Straps.....	120	.75	250	1.56
Outlet boxes.....	15	3.52	33	7.74
Plaster covers.....	11	1.42	27	3.49
Switch boxes.....	25	8.64	75	25.92
Ceiling box supports..	15	3.61	33	7.95
Switch box supports..	25	4.97	75	14.91
Misc.....		2.00		2.00
Labor.....		45.90		140.40
Total.....		\$117.94		\$315.04

On the same floor plan wiring is increased to allow for increased electrical utilization and compared with the cost of a minimum wiring job. Tables 9 and 10 are based

than area become more important. A small home fully equipped for electrical living may require a more elaborate wiring installation than a much larger home without modern electrical facilities. Such considerations are important for appraisal. A home equipped for electrical living is a better investment risk because it is a better place to live.

Future Capacity

The trends in appliances are toward higher wattage equipment. And appliances which are relatively new today probably will be commonplace tomorrow. Here are just a few; electric bathroom heaters, automatic washers, ironers, electric clothes driers (about 5 kw), attic fans, room air coolers, deep freezers, air cleaners and television sets.

To properly design a home wiring system probable utilization should be estimated on at least a 20 year span, still only a small fraction of the expected life of the house. But 20 years of electrical utilization development can encompass revolutionary changes, witness the past 20 years. It is doubtful whether our present trends can be projected for much more than a 10 year span on a practical basis.

Provision for electrical utilization growth is long term economy. Home wiring systems can be extended and expanded in capacity as new appliances are added. However, industry experience has demonstrated, 1) that the cost of such rewiring is much greater than equivalent facilities installed in the original wiring job, 2) the replaced service or wiring is rarely usable in the new system and is therefore a loss, 3) the cost of essential rewiring is often a critical factor in the choice of electrical as against competitive services or appliances, and 4) rewiring costs can delay and impede the adoption of new utilization equipment for the home.

In the new home special electrical facilities are installed as part of a comparatively large operation. Non productive

Table 10. Armored Cable

Roughing

Materials & Labor	Minimum		Adequate	
	Unit	Cost	Unit	Cost
14-2c cable.....	560	\$48.20	510	\$43.80
14-3c cable.....	35	4.21	290	34.90
12-2c cable.....			310	34.60
Connectors.....	84	10.40	226	28.10
Cable straps.....	120	.75	250	1.56
Outlet boxes.....	15	3.52	33	7.74
Plaster covers.....	11	1.42	27	3.49
Switch boxes.....	25	8.64	75	25.92
Ceiling box supports..	15	3.61	33	7.95
Switch box supports..	25	4.97	75	14.91
Misc.....		2.00		2.00
Labor.....		45.90		140.40
Total.....		\$133.62		\$325.37

on non-metallic sheath cable and armored cable respectively. Unit lists show the increased quantities required. Prices are typical day values.

Table 11. Electric Metallic Tubing

Roughing

Materials & Labor	Minimum		Adequate	
	Unit	Cost	Unit	Cost
1/2 in. E. M. T.....	570	\$45.60	1160	\$92.74
Couplings.....	40	6.00	81	12.15
Connectors.....	86	10.96	225	28.65
Straps.....	60	.32	140	.76
Outlet boxes.....	16	3.76	33	7.74
4 in. sq. boxes.....	10	2.83	34	9.53
Switch boxes.....	14	4.41	32	9.85
Round plaster covers	11	1.42	27	3.49
Switch cover 1g....	9	1.62	25	3.65
Switch cover 2g....	1	.22	9	1.98
Ceiling box supports	15	3.61	33	7.95
Sq. box supports...	10	2.40	34	8.16
Switch box supports	14	2.78	32	6.36
No. 14 wire.....	1400	25.80	2250	41.50
No. 12 wire.....			710	17.60
Misc.....		2.00		2.00
Labor.....		91.80		234.90
Total.....		\$205.53		\$489.01

Comparisons in cost between minimum and adequate wiring for roughing in an electrical metallic tubing job on the basis of the same layouts as the cable jobs above.

RESIDENTIAL WIRING COSTS (continued)

and overhead costs are lower, job efficiency is higher. Adding similar facilities after the building is completed and occupied involve further cutting, patching and other mechanical work which may exceed the cost of the actual electrical work. When service entrances must be enlarged, the original work is usually abandoned and renewed. For example, if 3 No. 8's are installed in the original work and five years later utilization requirements call for 3 No. 2's, the home owner has paid for 1) the original service, 2) the new service and 3) the added costs of removing the original service and installing work in a finished building. Thus cutting the original wiring plan to hold first costs down with the prospect that the deficiencies can be made up later by rewiring is both expensive and wasteful.

We pointed out earlier in this article that wiring systems are only a means to achieve the comforts and conveniences of electrical living. When wiring systems are cut below expected load or do not provide capacity for utilization growth, the deficiencies are rarely made up by rewiring or adding additional outlets and capacity until long after the wiring system has ceased to perform its original purpose. The home owner is much more likely to adapt his standards of electrical living to the wiring system deficiencies. We must remember that to him the deficiencies appear in the appliance or apparatus.

Table 12. Finishing

Materials & Labor	Minimum		Adequate	
	Unit	Cost	Unit	Cost
Duplex recept. and plate	11	\$4.19	37	\$14.10
W. P. receptacles			2	2.46
Clock receptacles			1	.84
Pilot			2	2.58
Switches s. p.	12	5.36	19	8.48
Switches 3w.	2	1.26	10	6.32
Switches 4w.			2	6.06
Switches door			4	7.48
Switch plates	14	1.43	26	2.98
House number light			1	1.30
Night lights			5	6.50
Laundry recept.	1	1.40	1	1.40
4 in box receptacles	3	1.08	4	1.44
30 amp. switch fused	1	2.23	1	2.23
Misc.		1.00		1.00
Labor		20.25		70.30
Total		\$38.20		\$135.47

Finishing work costs compared for minimum and adequate layouts. Finishing is substantially the same for any of the three types of wiring systems discussed.

Table 13. Signals and Radio

Materials & Labor	Minimum		Adequate	
	Unit	Cost	Unit	Cost
Bell wire duplex	80	\$1.50	80	\$1.50
Staples	20	.20	50	.50
Radio outlets			5	10.00
Twin lead 300 ohms			100	4.50
Push buttons	2	.44	2	.44
Combination bell	1	1.22		
Chime			1	6.20
Transformer	1	2.19	1	2.19
Misc.		1.00		1.00
Labor		4.05		14.80
Total		\$10.60		\$41.13

Signals and radio wiring costs compare minimum and adequate layouts. The amounts involved are small for the conveniences and values provided by good practice.

Table 14. Service, Range and Water Heater Circuits

Service 3 No. 2 100 amp. entrance switch combination panel with 10 branch circuits

	Cable	Conduit
Service and panel	\$121.29	\$150.08
Range and water heater circuit	36.11	64.18
Total	\$157.40	\$214.26

Service and range circuits were figured on typical methods using cable and conduit. Local practices vary, but the values shown are representative.

For example, a line of electric roasters once introduced in a middle west city showed fine acceptance at first, then started to come back in large numbers. The sales demonstration was excellent and convincing. The product was well made, efficient, economical and attractive but operated at a relatively high wattage. In homes, on overloaded circuits, they blew fuses, worked too slowly. The buyers complained, not about the wiring, but about the roaster. It was troublesome and inefficient.

Here is an important reason why inadequate wiring can "get by", why a minimum wiring system is often uncritically accepted by a home buyer. Provided there are a reasonable number of outlets for convenient attachment or extension cords and proper circuit protection, he is unlikely to have much trouble with the wiring system, nor is he likely to recognize its inadequacy in other than superficial character-

Table 15. Cost Comparison
Non Metallic Sheath Cable

	Minimum	Adequate
Rough wiring.....	\$117.94	\$315.04
Finishing.....	38.20	135.47
Signals.....	10.60	41.13
Service (cable).....	51.84	121.29
Range and water heater (cable)....		36.11
Job expense.....	22.00	25.00
Total.....	\$240.58	\$674.04

Armored Cable

	Minimum	Adequate
Rough wiring.....	\$133.62	\$325.37
Finishing.....	38.20	135.47
Signals.....	10.60	41.13
Service (cable).....	53.73	121.29
Range and water heater (cable)....		36.11
Job expense.....	22.00	30.00
Total.....	\$258.15	\$689.37

Electrical Metallic Tubing

	Minimum	Adequate
Rough wiring.....	\$205.53	\$489.01
Finishing.....	38.20	135.47
Signals.....	10.60	41.13
Service (conduit).....	63.88	150.08
Range and water heater (conduit)....		64.18
Job expense.....	22.00	30.00
Total.....	\$340.21	\$909.87

Totalling the complete wiring jobs on the basis of three wiring systems shows the necessary cost increments to meet modern utilization requirements.

istics. Unsatisfactory performance of utilization devices is tolerated as an inherent evil. If water damaged the plaster or the wall paper, he would promptly call a plumber or a roofer, not the paper hanger. But if lights burn dim or cooking is slow, the trouble is rarely referred to the wiring system.

This attitude is often reflected in building circles. Wiring in excess of minimum code standards is considered uncritically as superior quality which can be trimmed when budgets are tight. Let us examine this approach by first reducing our job absurdly to one outlet. Here is ridiculous inadequacy. From this extreme we may move step by step to lay out a minimum wiring job that will serve the home buyer's immediate requirements without reference to any standard. He must have lights in each room, appropriate switching. Then convenient points of access for lamps and

appliances without recourse to dangerous extension cords. Fixed appliances must be provided for. Circuit protection and feeder capacity must be installed to serve the various loads. Then reasonable provision must be made for appliances and equipment the owner is likely to buy in the immediate future.

With such an approach, we shall inevitably come out with a wiring system well beyond code minimum.

The National Electrical Code says specifically, "The provisions of this code constitute a minimum standard. Compliance therewith and proper maintenance will result in an installation reasonably free from hazard, but not necessarily efficient or convenient. This code is to be regarded neither as a design specification nor an installation manual for untrained persons. Good service and satisfactory results will often require larger sizes of wire, more branch circuits and better types of equipment than the minimum which is here specified."

To consider wiring beyond code minimum, therefore, as a negotiable area which can be trimmed without seriously affecting essential adequacy is completely erroneous. A good wiring installation can be reasonably assured if it is made in accordance with the standards set forth in the "Handbook for Residential Wiring Design". A full analysis of

Table 16. Layout Schedule

Lights—ceiling.....	19
Lights—side.....	14
House number.....	1
Recept.—duplex.....	37
Recept.—laundry.....	1
Recept.—weatherproof..	2
Recept.—clock.....	1
Pilot lamp.....	2
Night light.....	5
Radio outlets.....	5
Switches sp.....	19
Switches 3w.....	10
Switches 4w.....	2
Switches door.....	4
Oil burner connection....	1
Attic ventilator connection	1
Kitchen ventilator.....	1
Dishwasher.....	1
Disposal unit.....	1
Hot water heater.....	1
Range.....	1
Outlets.....	129
Circuits.....	10
Service 3 No. 2.....	100 amp.

Layout schedule for an adequate electrical system on the floor plan shown on page 73. In the preceding tables it is compared with the minimum plan layout in Table 1.

RESIDENTIAL WIRING COSTS (continued)

Table 17.
Underground Service

	Unit	Cost
Trench and fill	50 ft.	\$22.50
Conduit	10 ft.	4.69
Elbow	1	1.65
Cable 3 cond. No. 2	80 ft.	79.65
100 amp. switch fused	1	16.84
Panel	1	30.22
Grounding		7.50
Misc.		5.20
Labor		83.10
Total		\$251.35

Underground services are preferred in some areas, cost is little more than overhead service.

Table 18.
Bath Heater Circuit

Materials & Labor	Unit	Cost
Heater outlet 1500 W	1	See Note below
2 cond. No. 12 armored cable	50	\$5.58
Connectors	2	.26
Straps	16	.16
Panel circuit		1.40
Misc.		.50
Labor		7.87
Note: Inbuilt bathroom heaters are usually provided with a switch and a terminal box or knockout in the cabinet.		
Total		\$15.77

Bathroom heaters will eventually become standard equipment in even low cost homes; should have a separate circuit.

Table 19.
Multiple Outlet Strip

Kitchen	Unit	Cost
3 ft. sections	3	\$10.00
End blanks	1	.24
End feed	5	3.38
12-2 cable armored	35	4.30
Connectors	6	.76
Misc.		.40
Labor		5.59
Note: Replaces 3 plug receptacles.		
Total		\$24.67

Multiple outlet strip over kitchen work surfaces are convenient, their cost is moderate when installed with original wiring.

present and future load probabilities and the wiring facilities provided in the wiring plan, however, is the only sure test.

Estimating

The estimating methods commonly used for industrial and commercial jobs are unsatisfactory for house wiring. Complete detailed estimates are usually too costly and time consuming. Note the many tables and detailed computations in this article dealing with a single house, yet only a part of the original work sheets are shown, in some instances only the totals are given.

However detailed they may be, house wiring estimates should be prepared at retail prices. These studies are an example of this method. The contractor's costs are of no concern to the customer. Using only retail prices throughout the estimate and the proposal, all of the details are readily available for open discussion at any time. The various parts of the system can be analyzed and explained with their related costs always clear to the customer or prospect.

By always thinking and talking in terms of retail prices, the contractor or his salesmen avoid confusion and costly errors. If it is desirable to have some variations in the net price, the variations should be made as discounts from list prices, rather than markups on cost.

There are excellent electrical price services available at a very moderate annual cost. They provide suggested retail prices always up to date in convenient and efficient form. Several wholesalers prepare condensed catalogs with all prices shown subject to a uniform and convenient trade discount. Or the contractor can develop a retail price book of his own in any desired detail.

For estimating, the house job should be divided into from four to six elements. They are: 1) Service and panel feeders, and high current circuits, 2) Rough branch wiring, 3) Finishing, 4) Bells, radio and signalling, 5) Lighting fixtures and installation, and 6) Appliances and equipment.

Service entrances are subject to standardization on a relatively few types in any one community. This allows the estimator to set up detailed estimates for each type based upon average lengths. Per foot adders can then be used to adjust the average to specific conditions.

For instance, from the accompanying tables a service of 3 No. 2's in cable is based on a 25 foot service run. The cost is \$121.29. Nominal differences in service length can be adjusted at approximately the price per foot of cable.

Branch circuit roughing can usually be taken off on residential layouts without measuring runs. The amount of cable or conduit per outlet can be averaged over a number of jobs with considerable accuracy and will hold for almost all similar work.

Some estimators prefer a detailed listing of materials for branch circuit roughing and the use of unit labor factors. If wiring practices are standardized, however, it is easier and less subject to error to use average prices per outlet for roughing. In 50 outlets or more, minor cost variations from the average for each outlet are practically washed out. A separate unit should be developed for full circuit outlets and these should be listed separately. The same is often preferred for outlets on No. 12 appliance circuits. However, if the averages include an appropriate number of appliance circuit outlets they need not be separated.

Finishing work should be listed in detail. Such items as switches and receptacles offer an excellent basis for sales effort since they represent items which are seen and used

Table 20.

Multiple Outlet Strip

Living Room	Unit	Cost
6 ft. sections	6	\$19.98
Interior el	1	.98
Endfeed	2	1.36
Coupling	3	1.14
End blank	2	.48
Cable No. 12-2	35 ft.	4.30
Connectors	6	.76
Misc.		.40
Labor		9.64
Total		\$39.04

Note: Replaces 5 plug receptacles.

Living room multiple outlet strips are plug receptacle luxury at very slight additional cost in the average room.

Table 21.

Switched Receptacles

	Unit	Cost
Difference between 2 and 3w cable	45 ft.	\$1.67
Cable No. 14-2c	15 ft.	1.28
Switch and plate	1	.57
Labor		5.40
Misc.		.25
Total		\$9.17

Switched receptacles, one side hot and the other switch controlled are a highly salable convenience at only a slight cost.

Table 22.

Automatic Laundry Wiring

	Unit	Cost
3 cond. No. 8 armored cable 25 ft.	25	\$10.80
Connectors	4	1.08
Panel 1-35-2-20	1	11.70
Multiple outlet assembly 3 ft.	2	6.66
End feeds	2	1.35
Labor		13.50
Misc.		.40
Total		\$45.49

Automatic laundry equipment deserves modern wiring. This layout has a panel, dryer outlet and multi outlet assembly.

throughout the life of the house. Removed from the rough wiring the costs represented are very small and superior quality in wiring devices is much easier to sell.

Signal work, door bells or chimes and radio outlets should also be listed separately. These are items of growing importance in house wiring and they should not be thrown in as "miscellaneous". Good chimes can be fairly expensive but have strong customer appeal. For the builder they are a "feature" to help him sell. Radio outlets should be equipped with high frequency connectors and twin lead or coaxial risers to the attic space.

Lighting fixtures have not been discussed in this study because the subject deserves much more than the brief discussion which space would allow here. It will be the subject of a separate analysis in a forthcoming issue. The increase in fluorescent home lighting and the use of built in fixtures warrants the most careful and detailed estimating methods.

Residential wiring suffers chronically from underselling. Statistically it is one of our greatest markets for wiring. The total predicted for 1948 is in the order of half a billion dollars, more than in electrical work 20 years ago. Individual house wiring jobs, however, are small in comparison to the work of other trades. House wiring contractors are usually small business men willing to operate on thin margins and with minimum sales effort. Stiff competition prevails. Larger industrial and commercial contractors find house wiring, with the exception of mass housing developments, risky and often unprofitable. In most areas, however, one or two contractors, through specialized techniques, quantity purchasing and sound business methods have been notably successful in the field.

More realistic wiring plans, designed around an analysis

Table 23. Circuit Requirements For Home Equipment

Range (up to 12 kw.)	35 amp.	3 wire	115/230 volts
Range (over 12 kw.)	50 amp.	3 wire	115/230 volts
Water Heater*	20 amp.	2 wire	230 volts
Automatic heating plant (fuel)	15 amp.	2 wire	115 volts
Dishwasher and waste disposer	20 amp.	2 wire	115 volts
Automatic Washer	20 amp.	2 wire	115 volts
Dryer	25 amp.	3 wire	115/230 volts
Attic fan	20 amp.	2 wire	115 volts
Air Cooling Unit	25 amp.	2 wire	230 volts
Freezer	20 amp.	2 wire	115 volts

* Consult local utility.
(Source, Handbook of Residential Wiring Design).

Typical circuit requirements for modern home utilization. Most major appliances today should have individual circuits for proper operation and control.

of present and future utilization requirements can bring wiring into its proper place in modern housing and modern living. Better wiring inevitably brings more convenient and efficient utilization. As utilization advances the entire electrical industry moves ahead to new horizons. And the living standards of our nation rise to new levels.

Types and functions of signalling systems for modern hospital requirements.

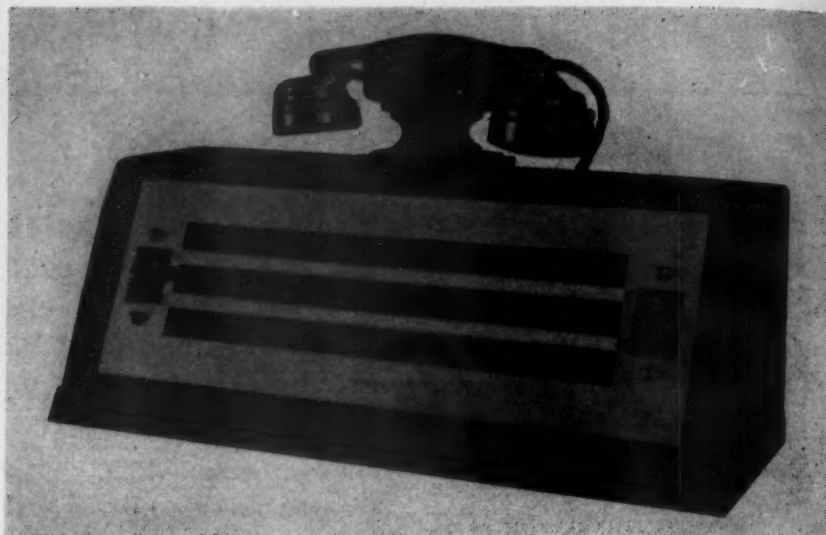


FIG. 2—Nurses' station incorporating lamp signals and bedside supervisory phone.

HOSPITAL SIGNAL SYSTEMS

HOSPITALS require a wide variety of different signaling and communication systems, which have proven to be very essential to the efficient operation of such institutions. The equipment has been designed to facilitate service to the patient both directly and indirectly. Service is rendered the patient by those who are constantly available by direct contact such as the nurse and personal physician, and indirectly by those in a consulting, observant and supervisory capacity

such as the chief surgeon, chief physician, internes and hospital staff. The safety of the patients, nurses and other members of the hospital staff have also been considered in the design and the type of systems available.

Generally there are four types of systems used in hospitals. (1)—Patients, (2)—Doctors and Staff, (3)—Personnel, (4)—Protective. The systems used by the patient are the Nurses Call, Bedside Servicephone, and the Sound and Radio. The systems used

by the doctors and staff are the Paging, In and Out, Emergency, Intern, Ambulance, Clinic, Interphone, Nurses Home Calls. The systems used by the personnel are Clocks, Dining Room, Laboratory, Door Calls, and the Elevator. The Protective systems are Psychopathic Alarms, Fire Alarm, Watchman's Report, and Sprinkler Alarm.

Nurses Call Systems are used by the patients to call a nurse to the bedside. There are in general two types of such systems, the Locking button and the Pull cord. Of the two the former is by far the most popular and versatile. By pushing a portable button, lights are caused to be illuminated over the patient's door in the corridor, duty rooms, diet kitchens and the nurses stations on a given floor or section of a floor. In the case of a ward a pilot light is included with the calling station or above the curtained cubicles to ascertain the origin of the call. The lamp signal at the nurse's station may be a single common lamp for a floor or section thereof or an annunciator with an indicator for each room. The choice depends upon the number of rooms, shape and size of the floors, the number of nurses available, and the amount of efficiency desired. In addition to the lamp signals a buzzer is located at each supervisory point such as duty rooms, diet kitchens and nurses stations together with a cut-off switch per-

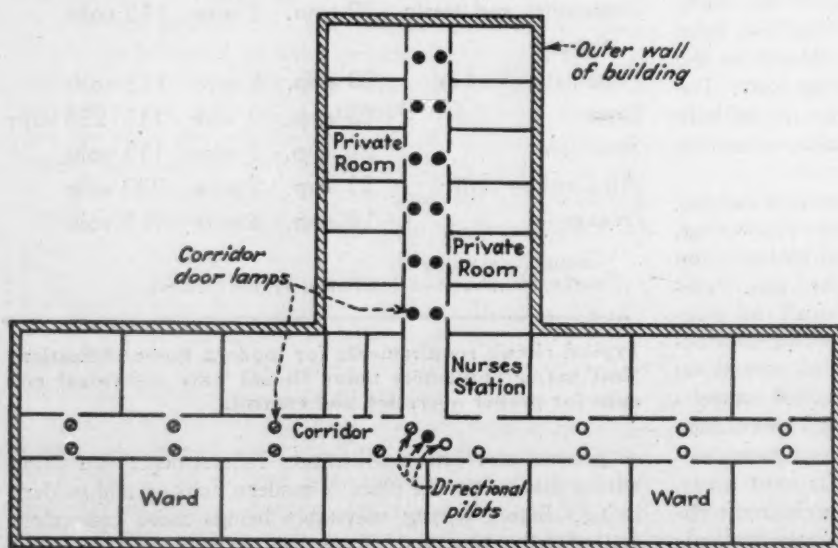


FIG. 1—Directional pilots are important adjuncts to corridor ward and room lamp signals.

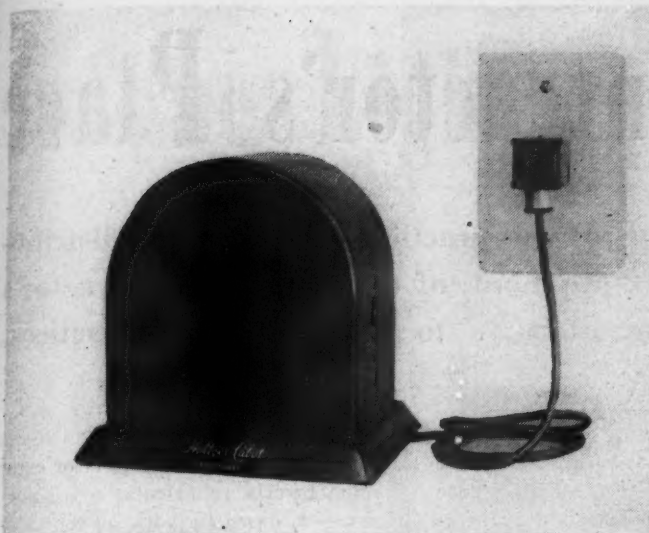


FIG. 3—Loudspeaker phone at bedside or in the wall operates to nurses' station when call button is pressed.

By A. A. Schuhler

mitting full control at all times. In large hospitals it is also desirable to install supervisory annunciators at the chief nurse's quarters which may have duplicated signals of those shown in the annunciator at the regular nurses stations. An elapsed time recorder may also be used for this purpose.

Directional pilots are of great assistance when used with nurses call systems. They are used to direct attention to the nurses while enroute between patients' rooms and points of supervision. They indicate the general direction of a call without having to return to a supervisory point. These signals may be used on a specific floor, a section thereof, or may interlock with other floors. A typical illustration of this feature is shown in Figure 1. Symbols of the same type operate together in the same area.

Nurses Call stations may be ganged on the same plate with other outlets such as radio, public telephone, duplex convenience receptacles, etc. A barrier must be provided in the outlet box wherever a lighting circuit enters adjacent to a low tension outlet.

The bedside servicephone is used in conjunction with the Nurses Call system and is a valuable adjunct since the nurse may converse with the patient and in that way can give better service and save considerable time and footsteps. In this system the patient pushes

the button in the usual manner and all lights and buzzers operate as previously described. The chief change is at the nurse's stations where in a new installation the annunciator is omitted since the lamps and control equipment are enclosed in one unit as shown in Figure 2. A loudspeaking unit, as shown in Figure 3, is located on the night table alongside of the patient's bed, or it may be located in the wall at the head of the bed. The first location is the best since the patient may talk in the direction of the loudspeaking unit. When the patient pushes the button, a lamp is operated at the nurse's station. A control key for that room is operated by the nurse and the circuit is completed for talking. All other lights in the corridor and supervisory points remain illuminated until the button is reset at the patient's bedside. A pre-heated amplifier furnishes energy to the system.

The sound and radio system enables the patient to listen in on one or more channels of radio programs, local, recordings, announcements, etc. Connection of the headphone or loudspeaker is made by plugging into the jack on the wall plate, usually ganged with the nurse's call station.

Paging systems are used to locate doctors and other members of the staff throughout the building. There are three general types of systems used,

silent, voice and sound. The silent system uses lamp annunciators throughout, but also incorporates an audible signal such as a buzzer or chime in the event an occasional selective signal is desired. The voice system consists of loudspeakers throughout.

The sound systems use bells, buzzer, sounders or chimes throughout. It has been recognized by leading hospital authorities that the silent system is preferable. The other systems are deemed by many as annoying to patients.

The methods of paging vary with the system employed. In the silent type as many as six persons may be paged at one time on a keyboard. Code numbers are used and assigned to each person. These numbers are usually composed of three digits although occasionally they may consist of one, two, three or four digits to increase the number of calls. In the voice system the name of the person being paged is mentioned through a microphone. In the sound system each person is assigned a code number which is transmitted from a central point to all audible signals.

In and out systems are used by the doctors and other members of the staff to designate whether or not they are present in the institution. Generally, an entrance register having a lamp and a switch for each person is located

[Continued on page 192]

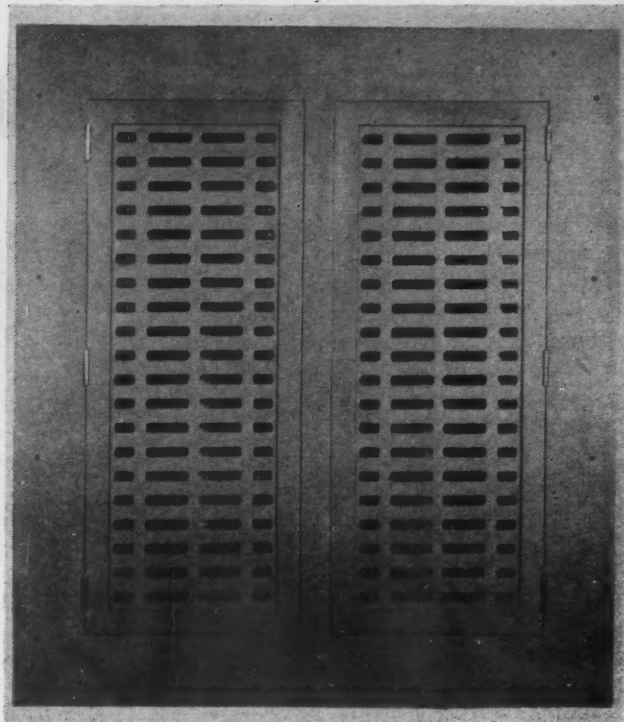


FIG. 4—In and Out doctors' register can be duplicated at entrance and office.

Electrical Contractor's Place

IN the factories, offices, schools and stores of this country are a number of people working, shopping or buying. It is necessary to augment natural light in these buildings with artificial light so that the many seeing tasks can be done not only better, but in comfort.

Most of these places could use better lighting. The lighting industry has the problem of bringing this fact to the attention of the individuals who are responsible for working conditions and for improvements in lighting. It is not necessary to go into details here, as the benefits of better lighting are well known.

In the lighting industry to do this job are the lighting equipment and lamp manufacturers, electrical wholesalers and their salesmen, and electrical contractors and their workmen, all working to sell this market. In between there is a vast amount of work that has to be done.

Manufacturers of lighting equipment and components, and lamp manufacturers have designed and are producing efficient lighting equipment to provide good lighting. Continued research and development have provided the technical "know-how" for applying these products to the lighting problems. These manufacturers are today spending thousands of dollars annually in telling the story of better lighting through advertising. This advertising may or may not reach the ultimate consumer. At best, that is about all it will do. Someone has to tell the story in person, correctly and convincingly. When this is done, then and only then is the ultimate lighting customer in a receptive mood for buying better lighting. The man who can change this *receptive mood* into a *desire*, and the *desire* into *action* is a most important man in the lighting industry. He is the *lighting salesman*.

When the salesman has performed his function, however, the sale has only started. The customer wants to know "How much will it cost?" before going ahead.

In order to answer this question, it is necessary for a *lighting engineer* to make a survey, prepare a lighting layout, and select and specify the number, location and types of lighting fixtures

An analysis of present practices of selling and distributing lighting equipment, of the Electrical Contractor's function, and of ways to improve these practices.

required to provide the proper quantity and quality illumination needed for the seeing problems which exist in the area to be lighted. The *lighting engineer* may or may not be the same individual as the *salesman*.

The selling job is still not finished. Under present practice, the *lighting engineer* turns over his lighting layout to the *electrical contractor* for quotation. The *electrical contractor*, in turn, must make a survey of present wiring conditions, and prepare an electrical wiring layout, involving proper voltages, circuits and controls, etc. He must then estimate the labor required to do the entire job, including installation of the lighting equipment. A trained estimator then lists all the materials and labor required to do the job, adds a percentage for overhead and profit, and prepares a quotation. Of the three individuals who have worked on this job up to this point, the *electrical contractor* is the only one qualified to close the contract—that is, "clinch" the order.

The *salesman* has developed the need for lighting, the *lighting engineer* has developed the lighting plans for the job, and the *electrical contractor* has developed the cost of doing the entire job, based on sound engineering practice for wiring and installing. Thus selling a lighting job requires the performance of three distinct functions. Each may be performed by a different individual, but could also be performed by only one individual if he had the necessary qualifications.

How Lighting Is Sold

Compare the above three-function selling technique with what ordinarily happens. Representatives of lighting equipment manufacturers normally sell their equipment to electrical wholesalers. They also contact architects and consulting engineers to have their own particular equipment specified on new or remodeling jobs. Many of them

also contact factories, offices and stores direct. It is not unusual for six or eight manufacturer's representatives, sometimes even more, to work on the same job. These men are usually qualified lighting engineers as well as good salesmen, but—none of them are in a position to "clinch" the order.

In addition, salesmen for electrical wholesalers contact electrical contractors, factories, offices, stores, and sometimes architects and engineers. These men are usually capable salesmen, but by virtue of the many product items handled, relatively few qualify as expert *lighting engineers*. They have the lighting equipment and related electrical wiring items in stock, but are without the expert knowledge required to do a proper job, and do not have all prices required to "clinch" the order for the complete job.

Contractor's Opportunity

Now comes the electrical contractor, and his place in the lighting industry. He is in the enviable position of having the opportunity to perform *all* the functions necessary to *clinch the lighting order*. But, is the electrical contractor qualified to perform all three functions? Unfortunately, he forms a weak link in the lighting industry chain.

Electrical contractors vary greatly. A majority have capable organizations, qualified to perform the normal function of the electrical contractor efficiently and effectively. Too many of them, however, are unqualified as *lighting salesmen* or *lighting engineers*. They are willing, and want to do a conscientious lighting job. But like the wholesaler's salesman, they have many other items to sell and problems to think about, and usually relegate lighting to a minor part of their thinking.

A strong electrical contractor group is needed to light American industry and commerce efficiently and at lowest cost. Each contractor should have well trained and efficient salesmen, who are

in the Lighting Industry

By Leo H. Camp, Jr.

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Leo H. Camp, Jr.

able to present well established lighting facts to all prospects, arouse interest in better lighting and create the desire to buy. If these salesmen are not also qualified illuminating engineers, then the contractor's organization should also include an equally well trained lighting layout and design engineer. Then with his normal construction and installation organization, the contractor is qualified to prepare a complete lighting recommendation including all costs, which the salesman can use and be in position to close the contract with the customer—"clinch" the order.

Such an electrical contractor should be soundly financed. He should have his own warehouse and stock normal quantities of standard fixtures, based on the size of his sales activity. In this way he could sell and install all normal size installations without delay. Large orders for fixtures which he is unable to handle from stock would then be ordered for direct shipment. A contractor with this type of organization, with a hard-hitting *salesman*, a proficient *lighting engineer*, and a warehouse *stock* would be performing those functions which fall logically into the sphere of the lighting contractor, many of which are now handled by wholesalers.

Lighting contractors of the type defined cannot work on the same margin of profit as the smaller contractor who is less ideally organized, and who now depends on the wholesaler to perform many of the necessary services. The lighting contractor must be protected. He must be paid for the additional service he renders in his creative selling and advertising, in maintaining a staff of trained salesmen, engineers, estimators, and installation mechanics, and for warehousing and financing. If he attempts to sell at higher prices than the average contractor who has none of these overhead expenses, his business is restricted. If he sells at the same low prices, he loses money and goes out of business fast. That is, if

he is required to pay the same price for his fixtures and supplies as the average contractor.

The lighting customer should pay only a fair price for his lighting. That price should cover materials and equipment, labor, costs of marketing and a conservative mark-up on these costs for profit. A variable is the "costs of marketing".

Marketing Costs High

Marketing costs now include handling costs and profits for the manufacturers' representatives, electrical wholesalers and electrical contractors. With manufacturers' representatives doubling up on sales effort on the same job, and with wholesalers doubling up on sales effort on the same job, plus performing many functions which a lighting contractor should do, and with contractors also marking up overhead and profit, the selling price is greater than it should be in most cases.

In one case investigated, covering one specific manufacturer's line of lighting equipment, the wholesaler marks up his selling price so that he realizes a 20 percent gross profit. For this profit he performs the following functions, which he considers necessary to do a good marketing job for the manufacturer: 1) purchases and stocks

large quantities of all types of fixtures in his warehouse where they will be readily available; 2) handles the stock coming in; 3) warehouses the stock; 4) has his salesmen contact contractors; 5) assists contractors in making layouts and selling customers; 6) ships to contractors on orders; 7) takes credit risks and finances contractor. For performing these many functions, which is not too far from average practice, it is believed that the wholesaler is entitled to this percentage as a normal mark-up. The fly in the ointment in this procedure for selling lighting, so to speak, is that many of these functions might be performed more efficiently and at less cost by a well-organized and qualified electrical lighting contractor of the type described previously.

Wholesalers and contractors must realize that whenever an article is increased in price it should be only for the adding of *time, place or use utilities*, that unless they add something to the value of an article, they are not entitled to any increase in price or profit. Under the present price structure both wholesalers and contractors are often being paid for the identical services in most instances, resulting in excessively high costs to the ultimate consumer.

Contractors, who are qualified lighting contractors as described previously, are not only competing with less experienced and less qualified organizations, but frankly are often competing with manufacturers and wholesalers who make a practice of selling direct to the ultimate user.

With the situation as it is, there has been no real incentive for the qualified contractor, who is doing an excellent electrical contracting job, to expand his organization as outlined so that he may also become a good lighting contractor.

When this situation is corrected, then enthusiastic contractors who desire to become lighting specialists and to build up an ideal organization to sell better lighting jobs, must employ *real salesmen* and *qualified illuminating engineers*. Then they will be able to do a creative job in selling "Better Light for Better Sight" to relight America.

Outdoor Sports and Recreation Lighting Techniques...PART II

More layouts and recommended practices for lighting outdoor games, swimming pools and play areas.

By Berlon C. Cooper

IN Part I of this series (*E. C. & M.*, April 1948), NEMA Recommended Practice for lighting softball fields, and basketball, volley ball and badminton courts were given. In this section, Part II, layouts and lighting techniques for other outdoor games and recreation areas are presented.

Outdoor Swimming Pools—Two methods of lighting outdoor swimming pools are used: underwater and overhead (Fig. 6). A simple layout is recommended for overhead lighting. A range of .5 to 1.25 watts per square foot is recommended, using open or enclosed floodlights, or ornamental type standards where decorative treatment is desirable. One unit should be installed per pole, with poles located 20 feet or more outside the pool edge. Spacing between poles should not exceed four times the mounting height.

For underwater floodlighting, a range of 1.5 to 3.0 watts of white light per square foot of pool area is recommended. Pool dimensions govern the number of units required and the size of the units. Spacing between units should not exceed values given in Table IV. Lamp size for each unit is dependent upon total wattage, and the number of units required.

The wet-niche method of installation, with the floodlight completely submerged, is recommended. The units should be watertight, of durable cast metal housing (cast bronze casings are recommended where chemicals are

used for water purification), and should be recessed in wall niches. Mounting details should permit units to be raised to the surface for servicing. Underwater floodlights should always be submerged completely before the current is turned on.

The dry-niche method of installation consists of installing the floodlight unit in a manhole in the pool wall, behind a glass lens gasketed into the pool wall through which the light from the floodlight unit is projected. Experience has indicated that difficulty is usually encountered in properly gasketing this glass lens into the pool wall. Otherwise, the same principles of layout and light distribution apply as for the wet-niche method.

Concentrated filament floodlight lamps are recommended for underwater floodlight units. Door lenses which give a horizontal spread of light are also preferable to symmetrical beam units. Tilting the units downward five to ten degrees from horizontal improves the lighting, and the walls and bottom of the pool should be finished white or in light color for best appearance and minimum light absorption. Colored door lenses may be used for spectacular effects, but will require an increase in wattage to compensate for light absorption of the color or colors selected.

Good lighting for swimming pools requires both overhead and underwater lighting. Visibility under water, ap-



Photo E—Golf driving range at Peabody, Mass., is lighted for night play by eight 1000 watt G. E. narrow beam floodlights and one 3 kw. airport projector. Lights strung overhead on messenger cable light players' area.

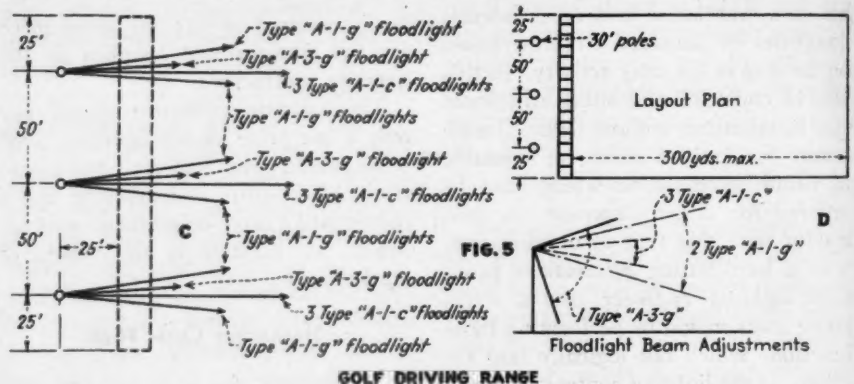


TABLE IV

SPACING OF UNDERWATER FLOODLIGHTS						
Type Lamp	A	B Maximum		C	E	
		D over 5'	D under 5'		Min	Max
(a) 250-400 w.....	4'	8'	10'	5'	12"	15"
(b) 500-1500 w.....	6'	12'	15'	7.5'	18"	24"

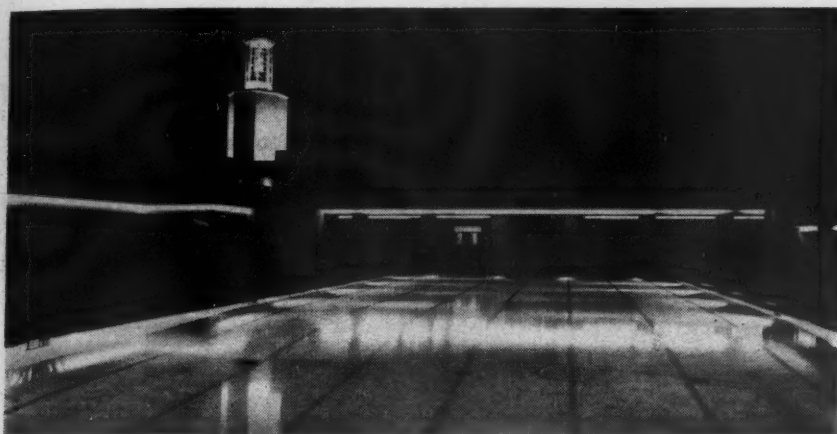
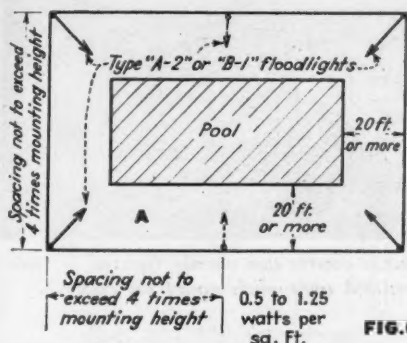
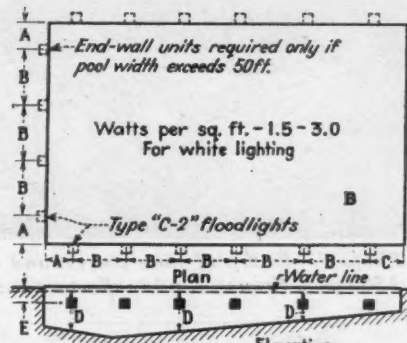


Photo D—Biltmore Hotel swimming pool, Santa Barbara, Calif, is underwater floodlighted by Westinghouse watertight units installed in walls of pool. Under-canopy lighting provides safety for spectators.



OVERHEAD FLOODLIGHTING



UNDERWATER FLOODLIGHTING

pearance, sanitation and accident prevention are best accomplished by underwater lighting, while overhead lighting provides for the safety and convenience of swimmers on the diving towers, and of spectators on the promenade.

Golf Driving Range—A typical layout for a golf driving range is shown in Fig. 5. Six floodlights, installed on a 30-foot high pole, are recommended for each five 10-foot wide driving mounds or stations. Three of the floodlights should be narrow beam enclosed type units, each equipped with a 1000 watt G-40 floodlight lamp, and directed to the far end of the range. Two units should be medium beam enclosed type floodlights, and installed to throw the

beam out horizontally to the central part of the range. These units should be equipped with 1500 watt general service lamps. One floodlight should be a wide angle type, enclosed, and equipped with a 1500 watt lamp. It should be focused to provide illumination over the driving stations.

These six floodlights should be installed in a bank with the three narrow beam units on a top cross-arm, the two medium beam units on a second cross-arm below the three units, and the wide angle unit should be installed under the second cross-arm. This method of banking provides a neat triangle arrangement of the units, and light from the wide angle unit is not obstructed by any of the other units.

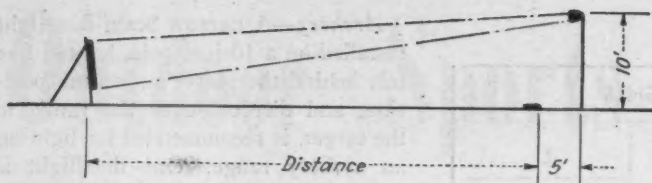
Archery—A narrow beam floodlight installed on a 10-foot pole, located five feet behind the player's shooting position, and directed over the range to the target, is recommended for lighting an archery range. One floodlight is recommended for each target (Fig. 7), and should be equipped with a 250 watt G-30 floodlight lamp for distances up to 30 yards, 500 watt G-40 floodlighting lamp for distances from 30 to 50 yards, and 1000 watt G-40 floodlight lamp for distances greater than 50 yards.

Trap Shooting—Fig. 8 shows the lighting layout for a trap shooting range. Eight medium beam enclosed floodlights, four on each of two poles, and each equipped with a 1000 watt PS-52 general service lamp, should be installed 20 feet from the ground. The poles should be located 25 feet apart and ten feet behind the shooting stations. The floodlights should be adjusted to provide evenly distributed light over the range area from the trap house to the limit of travel of the targets ("birds"), which will prevent the target from appearing to travel at different speeds as it would if intensities were uneven throughout the flight of the target.

Tennis—Tennis is a fast game. It requires a high level of illumination to permit successful night playing. More light is provided in the back-field for tournament tennis than is considered necessary for playground tennis. Thus for tournament tennis twelve floodlight units are recommended (Fig. 9) for a single or double court. For playground tennis eight floodlight units are recommended for a single or double court. On single courts 1000 watt general service lamps are recommended, and on double courts 1500 watt general service lamps are recommended. Floodlights should be installed 30 feet from the ground in all cases. This height provides uniform intensities and reduces glare.

The above layouts are in accordance with NEMA Recommended Practice. Another approach to playground tennis court lighting is the use of five 1500 watt wide angle reflector units installed 30 feet over the court along the centerline of the long axis of the court (Photo F), and equally spaced between the two ends of the court.

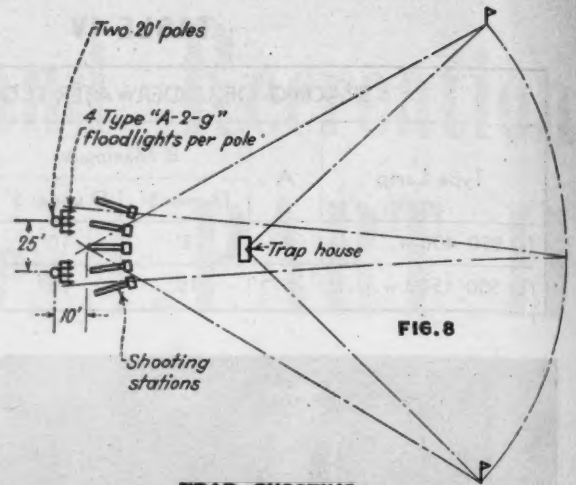
Horse Shoe Pitching and Shuffleboard—Similar layouts are used for both horse shoe pitching and shuffleboard courts (Figs. 10 and 11). The number of courts controls the number and location of floodlights and poles.



One Floodlight per target
Up to 30 yds. - Type "A-1-a" (250 watts)
30 to 50 yds. - Type "A-1-b" (500 watts)
50 to 100 yds. - Type "A-1-c" (1,000 watts)

FIG. 7

ARCHERY RANGE



TRAP SHOOTING

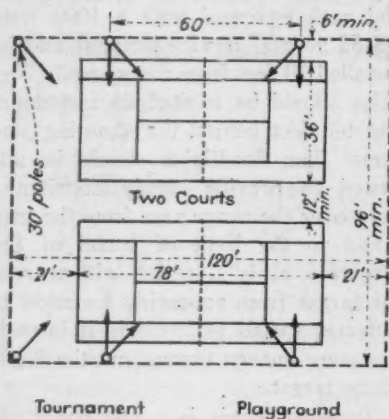


FIG. 9

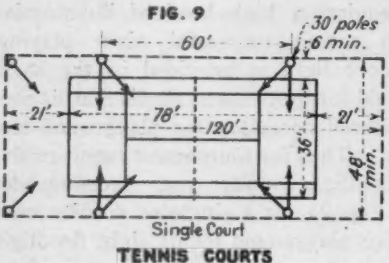


FIG. 10

TENNIS COURTS



Photo F—Group of nine playground tennis courts are evenly lit by five 1500-watt Crouse Hinds reflectors suspended over each court on cable.

(Table V). Two 500 watt wide angle open type floodlights, installed on 20 foot poles, are recommended for one to three courts, and four 1000 watt wide angle open type floodlights installed on 20 foot poles are recommended for from four to eight courts.

Operating Voltages—From an economic standpoint, sports areas which are night-lighted for less than 200 operating hours per year and using 1000 or 1500 watt general service lamps should be operated at ten percent overvoltage for maximum overall economy. If floodlights are used more than 200 hours but less than 500 hours, five percent overvoltage operation is recommended. Lamps operated over 500 hours per season should be operated at rated voltage. Ten percent overvoltage operation increases light out-

[Continued on page 131]

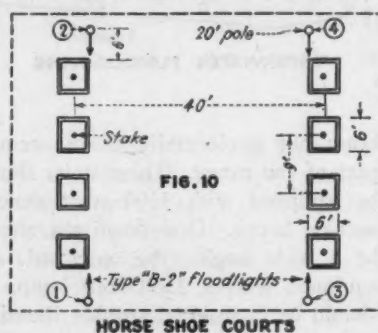


FIG. 10

HORSE SHOE COURTS

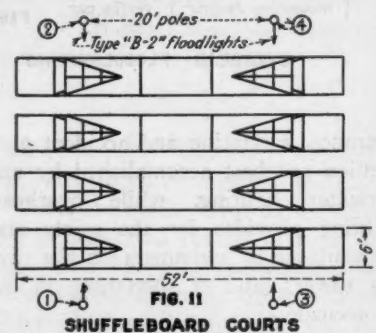


FIG. 11

SHUFFLEBOARD COURTS

TABLE V

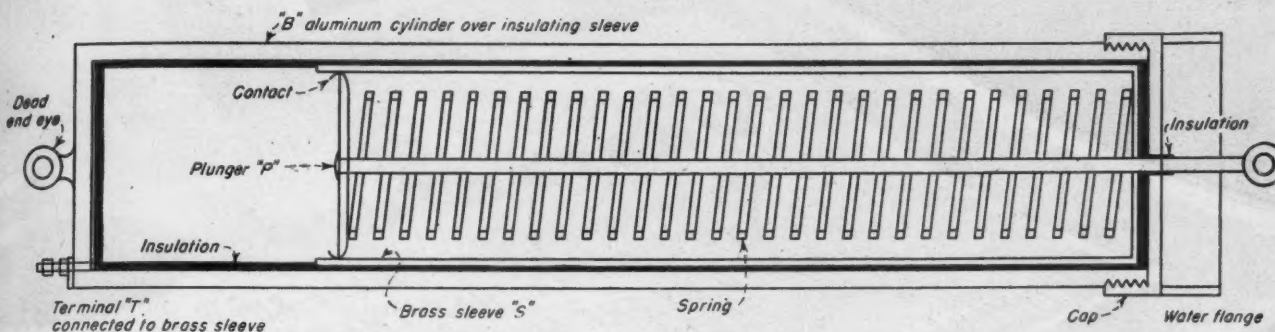
FLOODLIGHTING HORSE SHOE AND SHUFFLEBOARD COURTS			
Number of Courts	Floodlight Locations	Type Lamp	Type Floodlight*
1 to 3	1 and 4	(f)—500 w.	"B-2"
4 to 8	1, 2, 3 & 4	(g)—1000 w.	"B-2"

* See Table I Use one floodlight per pole.

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

Practical Methods

STRAIN CIRCUIT BREAKER



Sectional view through strain circuit breaker illustrating construction and operating principle described above.

Strain Breaker Kills Broken Overhead Line

WIRING

The old story of someone picking up a "live" wire lying on the ground because of an overhead line break is a familiar one. Frequently severe shocks result even on conventional 110-volt circuits, particularly if the ground is wet due to the rain or sleet storm that may have caused the break.

An outdoor strain circuit breaker developed by William C. Bedoit of the Chattanooga Armature Works, Inc., Chattanooga, Tennessee, may lead to elimination of this hazard. Possible low-voltage applications are seen on overhead lines on the farmstead, on the floodlighted recreational field, on the outbuilding connections to a residence, on circuit overpasses over a highway, or even on industrial crane trolleys.

Simple in construction and operating principle, the device was submitted as an entry in the 1947 Award Contest of the National Industrial Service Association. Details are presented here through the courtesy of the NISA Award Committee.

The circuit breaker is constructed of an outer aluminum cylinder "B" (see diagram) with an insulating sleeve lining throughout its entire length and at both ends. Inside the insulating sleeve, and extending about three-fourths of the cylinder length is a brass sleeve "S". A terminal "T" at the "insulated" end of the cylinder makes electrical connection to the brass

sleeve. Sliding inside and making contact with the brass sleeve "S" is a metal plunger "P" actuated by a strong spring. The end of the plunger rod, extending through an insulated and water-tight opening in the cylinder cap, is the other terminal of the circuit breaker.

The eye at the "insulated" end of the breaker provides dead-ending facilities for the overhead line. The service or feeder conductor is attached to its terminal "T". The "load" side of the overhead line is connected electrically to the eye of the plunger rod.

When the overhead conductor is pulled taut, the circuit breaker spring is compressed and plunger "P" makes contact with the brass sleeve "S" completing the circuit. If, for any reason, the line should break, the spring pushes the plunger back beyond the brass sleeve and onto the insulating sleeve. Once the plunger loses contact with the brass sleeve, the electrical circuit is broken and the ends of the broken conductor are dead.

The strain breaker is a single conductor device. One is needed in each phase or "hot" leg of the circuit to provide the desired protection.

Whenever use of new devices such as this is contemplated, approval of local inspection authorities should be first secured.

Another advantage obtained by using the strain breaker is the fact that, due to the spring construction within the cylinder, a certain amount of "give" is incorporated into the line and this flexibility relieves the impact of applied strains.

Square Duct Raceway Serves Motor Shop

WIRING

Square duct (4-inch) provided an economical and convenient raceway for power and lighting circuits in the motor shop of the Lima Armature Works, Inc., Lima, Ohio. Installation ease, circuit accessibility and provisions for switch and conduit connections led to its selection.

The main problem was to reduce to a minimum the number of conduits, panels and switches mounted to the walls. The square duct was suspended about 18 inches below the ceiling and equipped with anti-sway braces. Disconnect switches serving the various motors were mounted direct to the top of the duct (in this case the side, since the duct was turned 90 degrees so hinged cover would be on side). Feeder cables carry the 220-volt, 3-phase power from the main panel. Individual motor circuits are tapped on at the disconnect switch locations.

Lighting circuits (110-220 volt, single-phase, 3-wire) occupy the same raceway. Branch circuits to the fixtures enter the top of the duct. Lighting fixtures are individually fused at the raceway by means of a standard outlet box with sign receptacle and 15-ampere plug fuse. This prevents an entire circuit from being out of service should one unit short out. At various locations along the raceway, duplex receptacles are mounted for trouble lamps and portable tools. Keeping ex-

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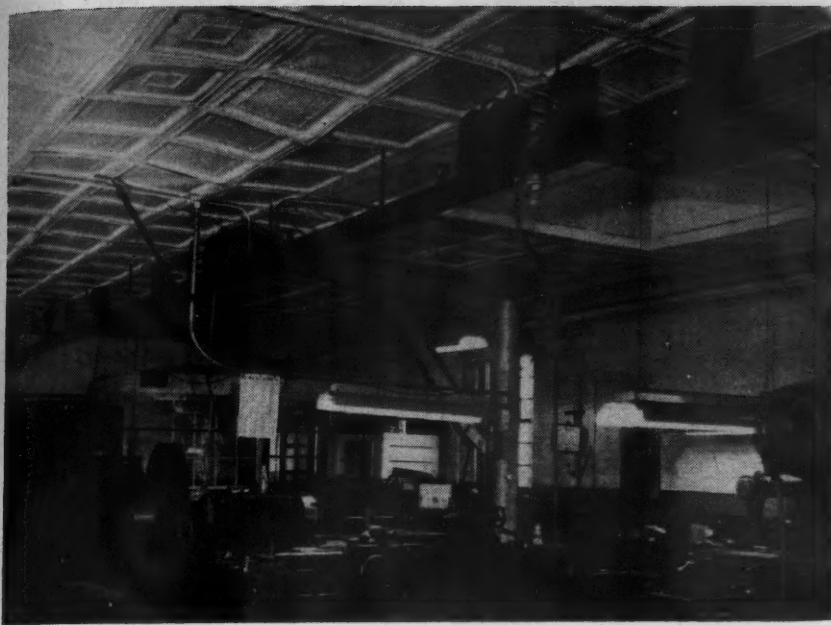
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Up and out of the way, square duct raceway serves the power and lighting needs of motor repair shop. Note motor disconnect switches and sign receptacles for individual fixture fusing mounted to top of duct.

tension cords off the floor in this manner minimizes tripping hazards.

On the opposite side of the shop where work benches are located, a line

of square duct is mounted to the wall at bench height. On it are installed the various receptacles and test outlets used for motor repairing.

Conduits Bent With I-Beam and U-Strap

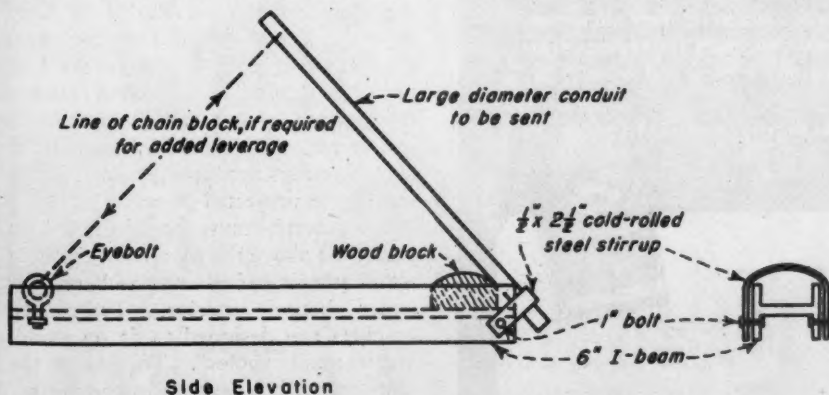
CONSTRUCTION

On a recent installation job, Frank Larke of Brooklyn, New York, was faced with the problem of making several bends in large-diameter conduit. A hydraulic bender was not available at the time and other means of bending the 3-inch conduit were impractical. However, a length of 6-inch I-beam was procured and a short length of cold-rolled steel, a heavy eye-bolt and two 1-by-2-inch bolts were obtained.

The $\frac{1}{2}$ -by-2 $\frac{1}{2}$ -inch cold-rolled steel strap was heated and bent into a U-

shaped stirrup and attached to the end of the I-beam as shown in the diagram. The heavy eye-bolt was fastened to the other end of the I-beam through the web. To this eye-bolt was attached a chain block, and a hardwood block was cut to rest between the I-beam flanges at the U-strap end.

In operation, the I-beam is rested upon the floor, the conduit to be bent is inserted into the steel stirrup, the wooden block is pushed snugly against the conduit and the hook of the chain



A pipe bender for large-diameter conduit can be made with a section of I-beam, a cold-rolled steel strap, two bolts and an eye-bolt. Additional leverage can be obtained by attaching a chain block between the eye-bolt and the conduit end. A hardwood block is pushed beneath the conduit at the strap end to provide the necessary fulcrum for bending.

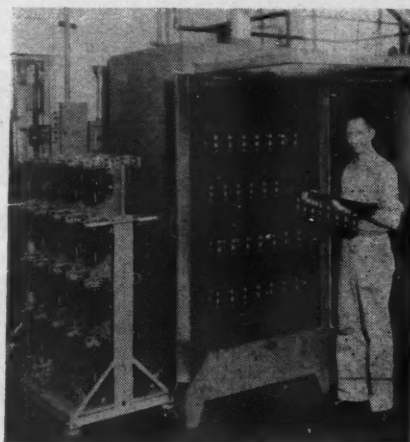
is passed over the opposite end of the conduit. Manual effort is multiplied by the chain block as well as by the principle of the lever. Bends were made easily and rapidly.

This assembly has been used to advantage on numerous occasions since its emergency invention, and it is now a standard item when large diameter conduit is encountered on installation projects.

New Oven Boosts Quantity and Quality

MANUFACTURING

In an attempt to stabilize the market prices of small motors, manufacturers are devoting considerable research to discover methods for improving plant efficiency, speeding operational cycles and reducing the labor required to complete various functions. One such manufacturer found the partial solution by installing a bank of new baking ovens in his plant. Having large capacities, critical temperature control,



Vertical oven conserves floor space and, using special shelfhook hangers, it is possible to simultaneously bake a gross of small fractional-horsepower armatures. Racks are removed when larger units are baked. Heavy insulation and controlled draft are design features.

regulated air intake and exhaust, rapid baking cycles and several safety features for insuring the comfort and health of the operators, the ovens selected have materially reduced baking time, operation costs have been reduced slightly as a result, the quality of the finished product has been improved, daily production has been stepped up and floor space has been conserved.

Conservation of floor space results from the vertical construction of the

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baking units. Several tiers of hooks and racks within the ovens permit hanging armatures by means of shaft-grasping hooks. Thorough insulation and large capacity blowers prevent excessive heat radiation, a feature which is appreciated in confined areas. Not only is the blower-exhaust system important for reducing surrounding temperatures, but it insures an adequate supply of oxygen for satisfactorily baking the insulating varnishes.

The ovens, manufactured by the Despatch Oven Company of Minneapolis, were designed for either gas or electric operation. They are self-contained units with the connection of lead-ins as the only installational requisite. Easy loading and maximum use is possible by using special loading dollies and shelf arrangements. It is possible to maintain temperatures above 500 degrees F, and high volume air flow can be regulated up to three complete changes a minute. Controlled exhaust and complete rockwool insulation are incorporated features.

For speeding coil and armature baking, the ovens have more than justified their cost price and even, rapid and thorough baking is a certainty for synthetic varnishes having exacting temperature and air requirements.

Reflector Floods

Light Plant Grounds

WIRING

Inconspicuous, effective and economical are terms that best describe the floodlighting at the new Cambridge, Ohio plant of the Kingston-Conley Electric Company, Division of the Hoover Company.

Type PAR 150-watt flood lamps (with silvered reflector in lamp) are used instead of the conventional metal reflector and lamp. Porcelain lamp sockets are mounted in deep cast metal housings that enclose all but the lens of the lamp. Asbestos gaskets between the housing lip and lamp make the unit watertight. Adjustable brackets on the lamp housings permit directional focusing of the projected beam.

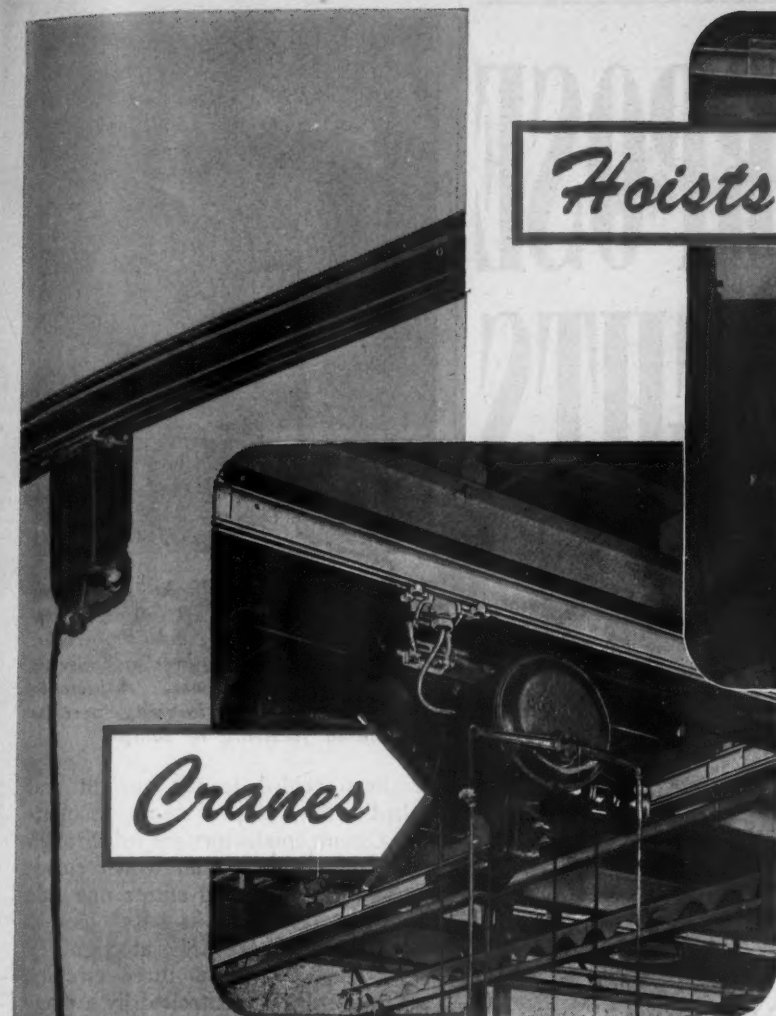
In general, units are installed in pairs just above the parapet of the long manufacturing building and on the boiler house exterior. Twin unit brackets are designed to fit on standard conduit "poles". To mount the units to the building walls, the Gustav Hirsch Organization, Inc., Columbus electrical contractors on the project, designed a simple support. It consists of a short conduit upright on which the twin lamp bracket is turned. Angle

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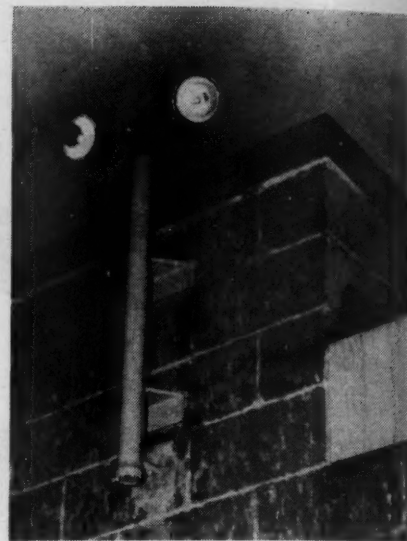


Floodlights

For more information, phone your nearest G-E agent, or write Apparatus Department, General Electric Company, Schenectady 5, N. Y.

GENERAL  ELECTRIC

461-114



Typical outdoor floodlight installation using two 150-watt PAR lamps. Sleek support consists of conduit upright, welded mounting brackets and circuit conduit stub at base. Adjustable mounting of lamp housing permits directional focusing of lamps.

brackets welded to the upright and bolted to the wall provide rigid mounting. Circuit conductors are fed through a 1/2-inch conduit stub which comes through the wall and enters one side of the upright near its base (base is capped). All joints are watertight.

Floodlights are on three circuits, each of which is controlled by a magnetic contactor operated by a remote control switch.

Similar PAR lamps in single housings are installed on each side (outside) of ten doors in the south wall of the long enclosed loading dock. Their small physical size permits installation here where clearance between building and freight car on the siding is limited. They can also be positioned so their beams will illuminate a portion of the interior of freight cars being loaded or unloaded.

Use of PAR lamps reduces floodlight maintenance to routine lamp replacement when burnouts or breakage occur.

Fuse Protection for Substations

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A note of international cooperation is sounded by A. W. Carlson, a reader in San Salvador, Central America. The method for fusing which he developed is based on an idea of Distributing Engineer Hunter of the Shanghai Power Company. Mr. Carlson comments that: "There is little doubt in the minds of most operating superintendents that co-

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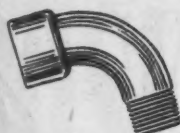


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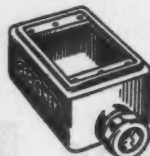
BUSHED ELBOWS



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PVX CONNECTORS



CONDUIT COUPLINGS



EMT BODIES



CONDUIT NIPPLES



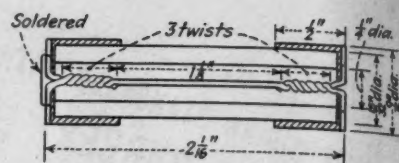
CORD GRIPS &
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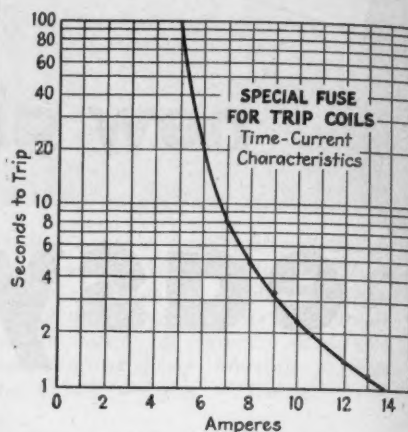
EMT BODIES



WATERTIGHT
BOX CONNECTORS



Fuse is constructed by cementing brass ferrules of cartridge fuses to short section of glass boiler gage tubing. Fuse element is 3-amp. fuse wire, soldered as indicated.



Fuse characteristics, when mounted in vertical position, are diagrammed with amperes plotted as a function of tripping period, measured in seconds.

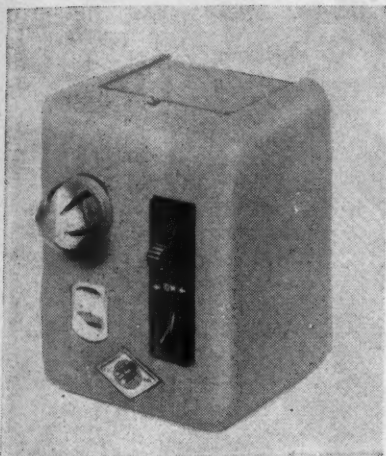
ordination between line fuses and substation switches pays dividends in service improvement. Many, however, are prevented from achieving these benefits due to the fact that substation breakers are controlled by old 5-amp. direct tripping coils. No time delay is possible without the installation of relays which are often difficult to obtain and expensive to install.

"A simple solution is the shunting of the trip coil with a fuse, the characteristics of which permit proper coordination with standard high tension fuses. After experimentation with many types of fuses, the one in the accompanying sketch was developed and has given excellent service for several years. The fuse, installed in parallel with the trip coil of a G.E. type HA operating handle has the characteristics shown in the diagram.

"The fuse is made by cementing two brass ferrules of standard 30-amp. cartridge type fuses to a short section of glass boiler gage tubing. Litharge-glycerin cement is used. The slots in the ends of the ferrules are soldered as shown. The fusing element is made from two pieces of 3-amp. fuse wire. The wires are twisted at either end and excess wire is cut from the center section. Uniformity of fuse characteristics results.

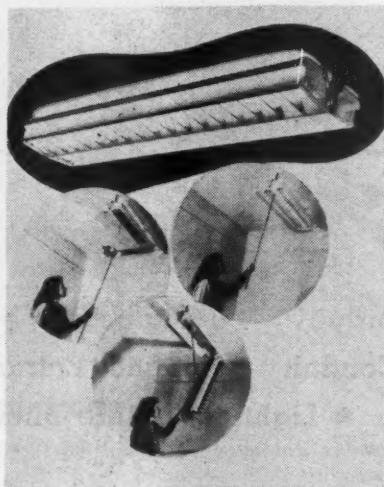
"Fuses should be mounted vertically to insure constancy of current-time characteristics. The trip coil is adjusted for about 4 amps."

Equipment News



Circuit Breaker

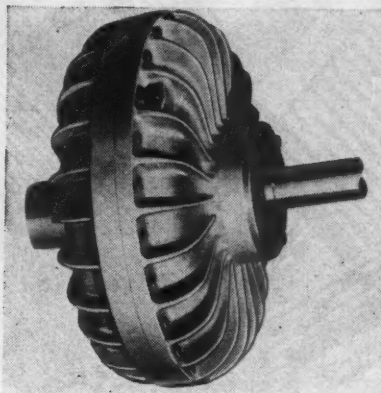
On this circuit breaker, known as Safelet, a pilot light shows when circuit is in use. It cuts out on dangerous overloads and opens on short circuit. It is for use on the assembly line, home work bench, laundry and many other applications. Ratings are 6, 10, 15 amps., 115 volts; 6, 10 amps., 230 volts. Heinemann Electric Co., Trenton, N. J.



Fluorescent Fixture

This new fluorescent fixture, called Guth-Lite, features a unique "Jackknife" hinge which cuts maintenance and installation costs. A light weight maintenance rod takes the place of the conventional ladder for servicing and cleaning, to lower its reflector assembly. The reflector assembly includes lamps, lamp-holders, starters, ballast, wiring, reflectors and louvers. Reflectors and louvers can also be cleaned from the floor. The separate reflector assembly includes all

wiring and accessories and is joined to the channel by the "Jackknife" hinge. Fixtures use two 40 watt or two 100 watt lamps. The Edwin F. Guth Company, 2615 Washington Avenue, St. Louis 3, Mo.

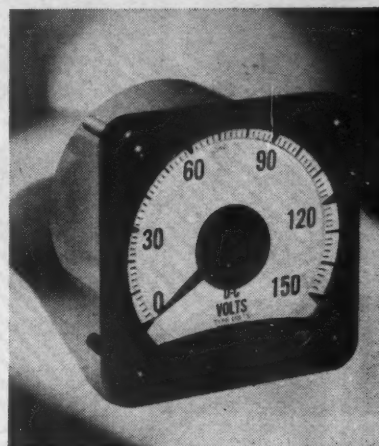


Hydraulic Coupling

Cartridge-mounted shaft bearings are designed as an integral part of a new "Fluidrive" hydraulic coupling. The shaft-end bearings in the drive coupling itself, assure permanent shaft alignment, prevent shaft play, possible damage to Neoprene bellows seals and subsequent oil leakage. It is self-contained, with simple impeller element and runner unit, mounted on its own integrally-fitted ball bearings. Straight radial vanes make possible operation in either direction. Low inertia of impeller and runner facilitates quick stops and reversing duty. Available in two sizes; 8.5 in., with capacity up to 5 hp., and 9.5 in., with capacity up to 7½ hp. CraneVeyor Corp., 1240 So. Boyle Ave., Los Angeles, Calif.

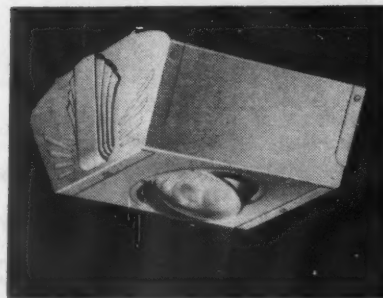
Testing Transformer

A new insulation breakdown tester that not only indicates grounds, shorts and opens, but also provides all voltages from 100 to 2500 in 100 volt steps, has recently been announced. The secondary test leads are equipped with "Safety Type Points" which are always in retracted position, sheathed in rubber jackets, unless pushed out with thumbs for testing. When thumb pressure is released, points retract. Equipped with red safety pilot light to indicate current is "on," and separate indicator light which will glow on partial shorts, lighting to full brilliance on complete insulation breakdown. Dongan Electric Manufacturing Co., 2985 Franklin St., Detroit 7, Mich.



Switchboard Instruments

A new line of long scale switchboard instruments employing bearings with spring-mounted jewels which work to protect the pivots under conditions of abnormal shock or abuse has been announced. Type AB-15, a-c and DB-15, d-c instruments are designed for general switchboard use by electric utilities and large industries. They have scales 7.1 inches long spanning 250 degrees about the center. New bearing construction permits hard use without harm to pivots. Instruments can be easily disassembled for inspection repair. They are mechanically interchangeable. General Electric Co., Schenectady 5, N. Y.



Spotlight

Two new commercial spotlight units, Model No. 345 for use with two 40 watt and Model No. 46 for use with four 40 watt fluorescent commercial fixtures have been announced. Both models use PAR-38 projector spot or flood lamp, adjustable in any direction by means of gimbal rings. Units may be used individually, inserted between two fixtures or added at either end of rows, flush or stem mounted. Units are of all steel construction, with removable decorative end ornaments. Mitchell Manufacturing Co., 2525 Clybourn Ave., Chicago 14, Ill.



Fittings for

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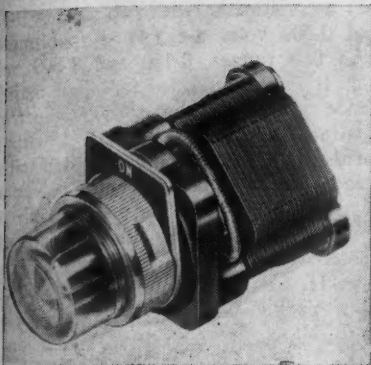
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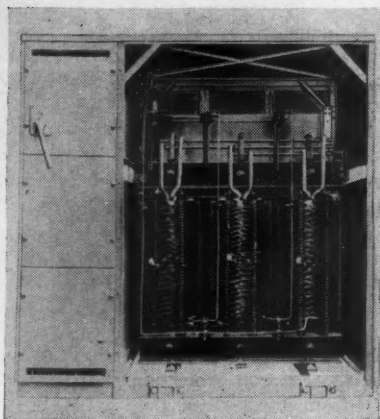
1639 WALNUT STREET

CHICAGO 12, ILLINOIS



Pilot Light

This new type oil-tight pilot light has been designed specifically for machine tool applications where cutting oils and coolants may cause an ordinary, general purpose type of pilot lamp to become inoperative. It is for panel mounting through a hole $1\frac{1}{2}$ inches in diameter. Construction permits mounting on panels as thin as $\frac{1}{8}$ in. or as thick as $\frac{1}{2}$ in. Color caps are available in clear, white, red, amber, green and blue. The a-c version has a built-in transformer permitting the use of a 6 volt, incandescent lamp with a miniature, bayonet-type base. The d-c employs a 110 volt candelabra screw base neon lamp. Series resistors are used for voltages exceeding 110 volts. Square D Company, 4041 N Richards St., Milwaukee 12, Wis.



Transformers

Dry type Class B insulated load center transformers for plant power distribution circuits are now being built in the following ratings: Three phase, 60 cycle, 100 to 2000 kva., with high voltages of 2400, 4160, 4800, 7200, 12,000, 13,200, or 14,400, and low voltages of 600, 480, 240 or 208Y/120. All are rated 80°C rise, with natural ventilation. Transformers are housed in paneled enclosures designed for indoor installation. Matching compartments for primary and secondary switchgear can be furnished as required, to form complete, closely coupled unit substations. Removable panels facilitate cleaning and inspection. Vertical ducts through core and vertical and horizontal ducts through

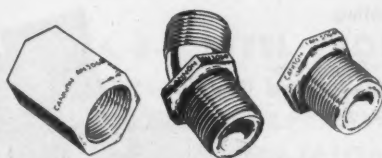
winding provide maximum ventilation and reduce internal temperatures. Insulation materials are mainly Class B; Class C materials are used where extra strength is needed. Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis 14, Mo.

Germicidal Sterilamp

A new bactericidal lamp that emits more than twice as much ultraviolet radiation as any lamp heretofore available has been developed. It is a 36 inch long, instant start, slimline germicidal sterilamp that may be operated at three different levels of ultraviolet intensity. The output varies depending upon the current rating of the ballast used with the lamp. It not only produces more ultraviolet for each watt of electricity consumed than previous lamps, but also provides an almost uniform level of radiation throughout life. The best electrical features of all previous ultraviolet lamps have been combined in this lamp, including the dual electrode that operates cold on instant starting and hot. The glass used for the lamp tube has resistance to solarization. Westinghouse Lamp Division, Bloomfield, N. J.

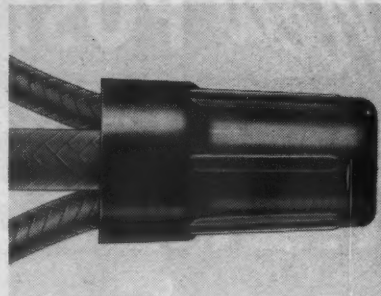
Lighting Fixtures

A new line of fluorescent and slimline executive luminaire lighting fixtures have been announced. Available in two and four lamp units, louvered or glass bottoms, for standard 40 watt fluorescent and 51 watt slimline sizes. Wafer-thin in depth, these fixtures are engineered for correct illumination and ease of maintenance. Provided with knockouts and finished in baked white enamel having a reflection factor of 87 percent. All-bright Electric Products Co., 3917 North Kedzie, Chicago 18, Ill.



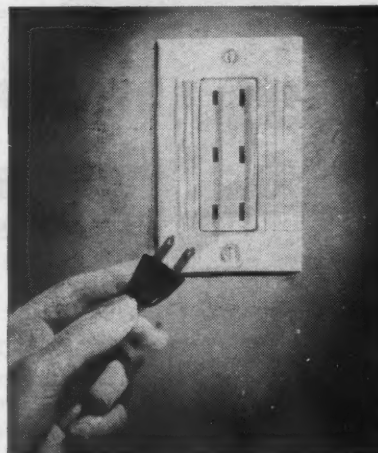
Conduit Fittings

The AN3060, 45° conduit coupling; AN3064 box connector, and the AN3068 conduit coupling adapter have been added to the AN line. The 3060 conduit coupling is used for connecting either flexible or rigid aluminum brass or other conduit; the box connector is used with 3066 conduit coupling locknut to form a termination inside conduit boxes or panel, and the 3068 conduit coupling adapter is used to make a coupling between any two male threaded conduit fittings. Standard finish is tin plate or natural. Cannon Electric Development Company, 3209 Humboldt St., Los Angeles 31, Calif.



Connector

A new type solderless pigtail wire connector and insulator, known as "Sta-Kon Wire Joint", has been announced. Approved by Underwriters' Laboratories for use in both circuit and fixture wiring. Maximum wire capacity of the joint is three No. 12 solid or stranded wires AWG. Over one hundred other smaller wire combinations can be used in same connector. Body of joint is made of bronze, electro-tin plated. Vibration-proof insulating cap is made of thermosetting phenolic material. Thomas & Betts Company, Elizabeth 1, N. J.



Receptacle

A new three outlet receptacle is now being produced which can be installed in standard boxes. "Sierra Triplex" receptacles have double contacts of heavy duty bronze and are side wired. They are rated 15 amp., 125 volt; 10 amp., 250 volt, and are approved by Underwriters' Laboratories. The receptacle and matching wall plate are designed as a unit and can be mounted either vertically or horizontally. Available in brown and ivory. McDonald Manufacturing Company, 544 East 31st Street, Los Angeles, Calif.

Instrument

A new insulation tester, called a "4 in 1", Megohmer because it combines four instruments in one as follows—(1) Insulation tester, 0-200 megohms with 500

New POSITIVE LOCK Construction of Monarch Renewable Fuses

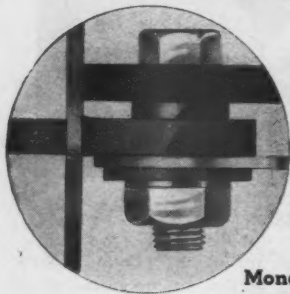
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TRUE ALIGNMENT



The brass lugs inside the caps used on Monarch Fuses (see illustration at right above) fit into equally spaced slots in the brass casing inserts. This new and improved Monarch construction assures true alignment of the copper holding terminals . . . and establishes a positive lock on both ends of the fuse.

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MONARCH'S Compressed Tension Lock Washer construction (illustrated at left) compensates for contraction and expansion of the fibre bar by exerting constant tension on the bar . . . and assures no loose parts. The washer also separates the fibre bar from the copper terminals . . . a spacer to provide better cooling.

Monarch Fuses are fully approved and are available through recognized wholesalers.

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FUSErvice

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volts d-c test potential (2) Ohmmeter, scale 0-2000 or 0-20,000 or 0-200,000 ohms (3) a-c voltmeter, with two ranges, 0-150 and 0-600 volts a-c (4) d-c voltmeter, with two ranges, 0-150 and 0-300 volts d-c. It is recommended for plant maintenance men, motor repair shops, electrical contractors, railroad electrical departments. It is a non-cranking tester with a steady test potential; source of power are two No. 6 dry cell batteries which are stepped up to 500 volts d-c by means of a special vibrator-transformer circuit. Herman H. Sticht Co., Inc., 27 Park Place, New York 7, N. Y.



Motor Control Center

A new motor control center which makes possible controlling any number of motors rated up to 200 hp. at 440 volts from one central location, has been announced. They are designed so that all connections can be made from the front, permitting centers to be lined up against the wall or in back-to-back fashion to conserve space. Centers consist of standard starter units which are slid into vertical, cabinet-type sections, measuring 90 inches high, 20 inches wide, and 12 inches deep. Starters are furnished in five sizes. Each starter has a built-in circuit breaker for short circuit protection. General Electric Company, Schenectady 5, N. Y.

Spotlight

A new incandescent spotlight, Dyna-beam Klieglight, has been announced. Intended primarily for spot and floodlighting the stage from distances of 75 to 150 feet, usually from the projection booth, it is also serviceable for other applications where long distance projection of an intense light beam is required. When used for spotlighting it is equivalent to a 70 ampere arc spotlight and for practical purposes serves as well as a 100 ampere arc unit. When floodlighting any area greater than 6 feet wide its light intensity is three to four times greater than 70 or 100 ampere arcs of any type. At a throw

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Improved wiring standards REQUIRE more boxes. Greater
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FOR LIGHTING CONTROL—TYPE T-27

Wide adaptability, low-cost installation and maintenance make the T-27 (shown above) suitable for all general-purpose applications.

Completely automatic control requiring no manual adjustment after initial setting.

Simple design, meaning fewer parts to wear—fewer places for trouble.

Easy to handle—hinged cover, plenty of wiring space, five standard knockouts for conduits.

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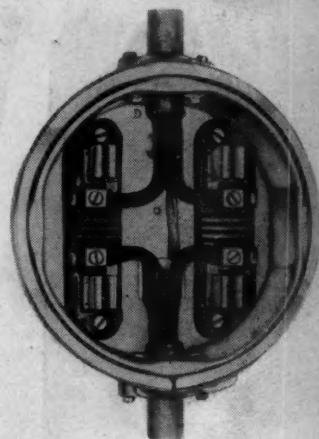
LIGHTING JOBS THE T-27 CAN HANDLE

- Spectacular sign displays
- Street lighting circuits
- Floodlighting of construction projects and amusement areas
- Floodlighting of buildings and monuments
- Store- and show-window lighting for after-dark displays
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- All-night lighting in apartment houses

An astronomic dial is available for dusk-down schedules—particularly popular for illumination of signs, billboards, and street lights. An omitting device can be furnished for omitting operation on any desired days of the week. For further information, call your nearest G-E apparatus office, distributor, or agency, or write for Bulletin GEA-3339. Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

GENERAL  ELECTRIC

of 100 feet it gives an average of 90 foot-candles for a spot 6 ft. or smaller in diameter or an average of 50 foot-candles for a 20 ft. spread. Standard voltage incandescent lamps used, arc lamp generating equipment is eliminated. Kliegl Bros., 321 West 50th St., New York 19, N. Y.



Aluminum Meter Socket

Production of a new drawn aluminum mounting socket for use with standard single phase socket type watt hour meters has been announced. Designated as Type D socket, it is intended to supplement rather than supersede Type S die-cast sockets. Type S die-cast sockets have threaded hubs and are designed for conduit connections. It is supplied without hubs, but with knockouts. By using a compression type fitting, it is possible to secure a water tight connection with cable in a knockout. It is suitable for more than thirty practical combinations of conduit, cable, and openings using cable from two No. 8 to three No. 2 and conduit from 1/2 to 1 inch. Sockets are furnished with terminal blocks and sealing rings. Duncan Electric Mfg. Co., Lafayette, Ind.

Converter

Special converters make it possible in direct current metropolitan areas to have television receivers in homes or offices. Converters are available for table model television receivers and for console models. No special wiring is required for converters, which operate with a new type automatic remote starting system. Either converter may also be used for wire recorders, radio-phonograph combinations, and office dictating machinery. Electronic Laboratories, Inc., Indianapolis, Ind.

Operators for Snap Switch

A new series of operators for precision snap switches has been announced. The switch is a small, self-contained contact mechanism for making or breaking a circuit with short movement and light pressure. The new series of three operators

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HAZARD ARMORED CABLE

For over fifty years Armored Cable has been providing a safe and low cost wiring system, and now with sizes 12 and 14 AWG you get still another improvement built into this outstanding cable—*bonding*.

A flat, tinned copper wire laid lengthwise of Hazard Armored Cable maintains intimate contact with every convolution of the steel armor and provides permanently low armor resistance. And under the provisions of the 1947 National Electrical Code, these two sizes are smaller and lighter in weight than ever before because of the new thinner insulation wall made of higher grade rubber.

Armored Cable provides the only available wiring system that incorporates a prefabricated cable with steel armor. Simple, quick installation is thus possible and long, trouble-free service assured. For full information on the new Hazard Bonded Armored Cable, ask your local Hazard representative or write The Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pennsylvania.

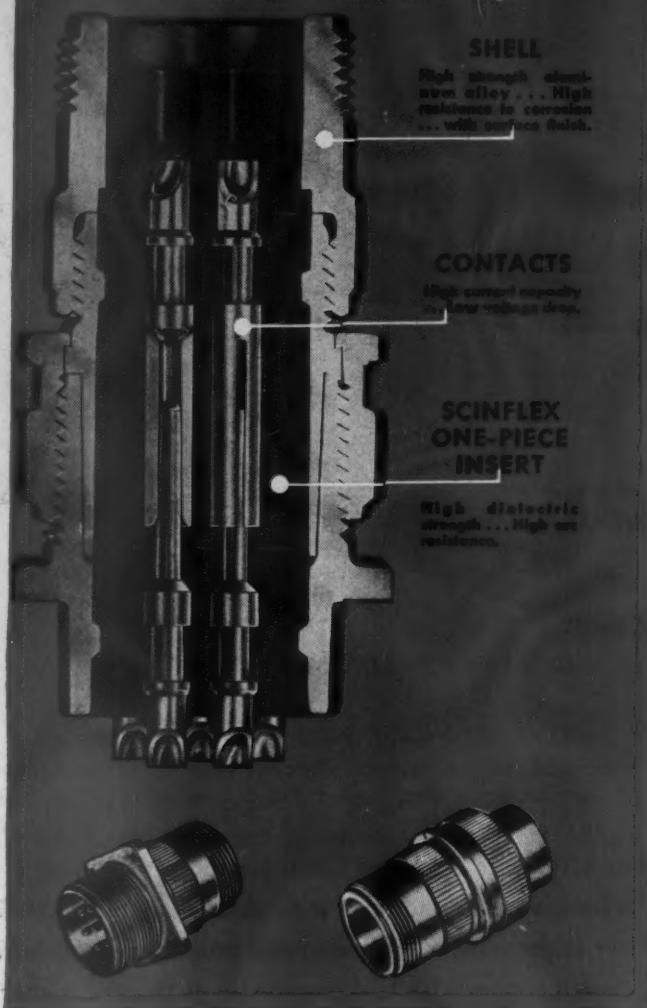
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Bendix-Scintilla* Electrical Connectors are precision-built to render peak efficiency day-in and day-out even under difficult operating conditions. The use of "Scinflex" dielectric material, a new Bendix-Scintilla development of outstanding stability, makes them vibration-proof, moisture-proof, pressure-tight, and increases flashover and creepage distances. In temperature extremes, from -67°F. to $+300^{\circ}\text{F.}$, performance is remarkable. Dielectric strength is never less than 300 volts per mil.

The contacts, made of the finest materials, carry maximum currents with the lowest voltage drop known to the industry. Bendix-Scintilla Connectors have fewer parts than any other connector on the market—an exclusive feature that means lower maintenance cost and better performance.

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Available in all Standard A.N. Contact Configurations



can be added to the basic mechanism to extend its industrial applications. Operators are provided in following arrangements—(1) Plunger-type, panel mounting switches consisting of basic snap switch mechanism in combination with a plunger-type operator. (2) Roller-leaf limit switches consisting of the basic contact mechanism riveted to an operating arm of beryllium copper. At the end of the arm is a non-metallic roller assembly, suitable for operation from a cam or other means. (3) Door type switches designed to function as an electrical interlock on a cabinet door. The snap action contacts are rated 600 volts pilot duty a-c or d-c. Square D Company, 4041 North Richards Street, Milwaukee 12, Wis.



Outdoor Lighting

A line of aluminum weatherproof lighting units for outdoor applications has been announced. Lampholder is for PAR-38 sealed beam floodlamps. Half-inch threaded fitting allows use singly on any standard fitting or with Rab-o-lite wiring trough. Groups may be mounted over gas station island light reflectors or flush against wall surfaces. Ball joint permits adjustment in any direction. All wiring enclosed. Rab Electric Mfg. Co., 7 East 199th Street, New York 58, N. Y.

Fuse Cutout

A new 50 ampere indicating enclosed fuse cutout for use on high capacity distribution feeders has been announced. It has an interrupting rating of 5000 rms amperes at 5000 volts, and 8000 rms amperes at 2500 volts. The housing is of wet process porcelain, glazed inside and out, with a hanger support cemented into the back. Contact clips and terminals are silver plated, and cemented into the housing. Stainless-steel springs reinforce contact clips. Clamp-type terminals having retracting clamping shoes are used. These are actuated by separate silicon-bronze large head screws. The door of cutout is of molded Textolite. Door hinges are so positioned that recoil forces act to hold door closed. The door is isolated from all

[Continued on page 192]

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Industrial Electrification

ENGINEERING • INSTALLATION • MAINTENANCE

Motor Performance

When Volts and Cycles Vary

How voltage and frequency variations affect induction motor performance

THE question sometimes arises concerning the effects of varying voltage or frequency, or both, on the operation of the induction motor. The effect of changes in either frequency or voltage, or both, will vary for different motors, depending chiefly upon the grade of iron used and the relative saturation of the various magnetic and electrical circuits. Assume a normal design, using a good grade of electrical steel. Let us see what effect plus or minus 10 percent variations will have on the motor.

Over-Voltage

For a given load, the power input to the motor is proportional to the voltage, current, power factor, and efficiency. Any change in voltage must be balanced by a change in one or more of the remaining factors to maintain the proper magnetic and electrical conditions necessary to carry the load.

An increase in stator voltage is accompanied by a decrease in full load stator current, a decrease in slip, and an increase in flux densities. Decreasing the stator current decreases the stator copper losses. The rotor voltage varies directly with the slip and the flux crossing the air gap. A 10 percent increase in stator voltage increases the air gap flux about 10 percent, but decreases the slip approximately 15 percent, so there is a net loss in rotor voltage. The rotor current is directly proportional to the rotor voltage at the low slip speeds. Therefore, a decrease in rotor voltage decreases the rotor current. This means a reduction in rotor copper losses. The increased flux

By C. Gentilini
Design Engineer
National Electrical Coil Company
Columbus, Ohio

densities means a larger magnetizing current, increased iron losses, and subsequent loss in power factor of approximately 3 percent. The sum of the decrease in losses of the stator and rotor is usually greater than the increased iron losses, so that there is about a one percent gain in efficiency.

To maintain the condition of equality

mentioned in the beginning of this article, there results a decrease of approximately 7 percent in the full load stator current to offset the 10 percent increase in voltage and the 2 percent reduction in the product of power factor and efficiency. With the 7 percent decrease in stator current there will be a decrease of 14 percent in stator copper losses. The rotor copper losses will be reduced approximately 2 percent.

The starting current of the motor is limited by the inherent design values

TABLE I
APPROXIMATE EFFECT OF SMALL VOLTAGE AND FREQUENCY
VARIATIONS ON INDUCTION MOTOR CHARACTERISTICS

Characteristics	Voltage Variation		Frequency Variation	
	+10%	-10%	+10%	-10%
Synchronous RPM.....	0	0	+10%	-10%
Slip.....	-15%	+15%	0	0
Core Loss.....	+ 8.2%	- 8.5%	+ 8.2%	- 8.5%
Primary Copper Loss.....	-14%	+22%	0	0
Secondary Copper Loss....	- 2%	+ 3%	0	0
Friction and Windage.....	+slight	-slight	+15%	-12%
Starting torque.....	+20%	-20%	-20%	+20%
Pull-out torque.....	+20%	-20%	-20%	+20%
Power factor.....	- 3%	+ 1%	+slight	-slight
Starting current.....	+10%	-10%	-10%	+10%
F. L. current.....	- 7%	+11%	-slight	+slight
Efficiency.....	+ 1%	- 2%	+slight	-slight

NOTE—The above values are variations from normal operating characteristics. Plus denotes an increase/minus a decrease. Changes in operating characteristics caused by a 10 percent increase in voltage can be read in the first column under voltage variation +10%. Voltage or frequency changes which fall within the ranges shown can be obtained by interpolation.

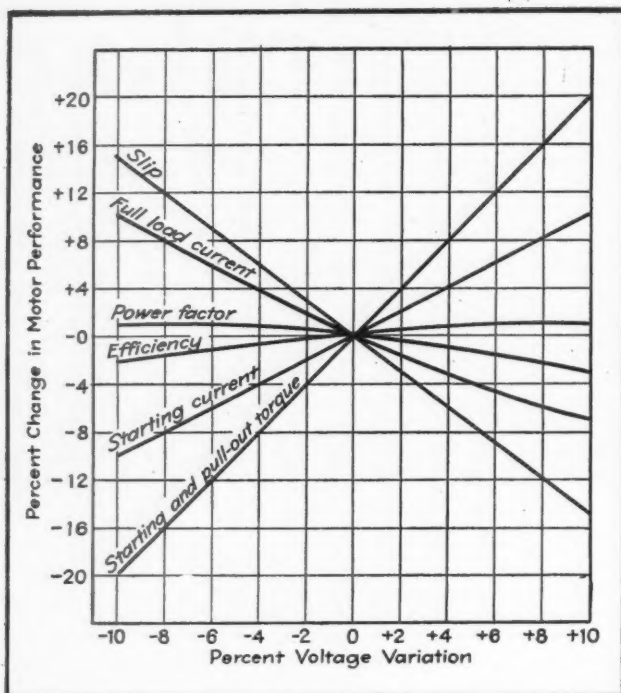


FIG. 1—Effect on motor performance when voltage varies.

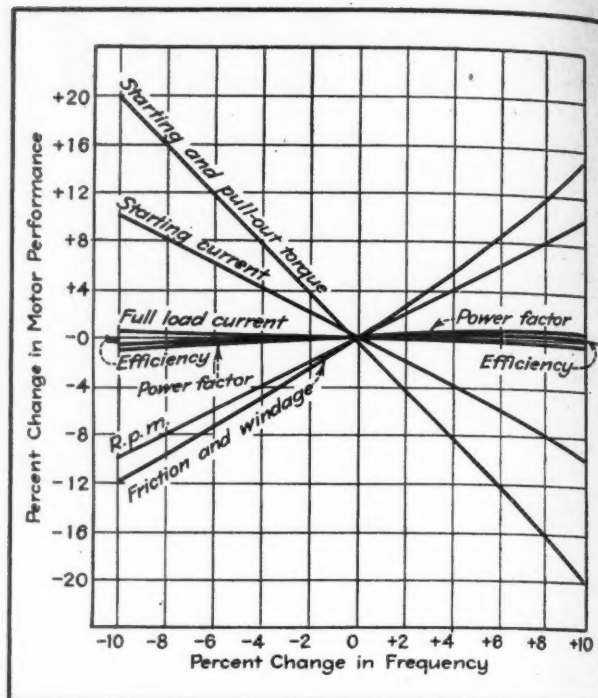


FIG. 2—Effect on performance when frequency varies.

which determine the impedance, or neglecting resistance, the reactance of the motor. Therefore, for a given design, a 10 percent increase in voltage is accompanied by a 10 percent increase in starting current. The same is true of the current at pull-out conditions, as shown in Fig. 1.

The starting and pull-out torques are proportional to the product of the flux and the motor currents at starting and pull-out conditions. A 10 percent increase in voltage is accompanied by a 10 percent increase in flux and a corresponding increase of 10 percent in current for both starting and pull-out conditions; the net result is a 20 percent increase in starting and pull-out torques. Since the change in voltage is responsible for the change in both flux and current, we can say that *the starting and pull-out torques vary as the square of the change in voltage*.

Under-Voltage

At the same loading, a 10 percent reduction in voltage means that the stator current must increase to maintain the magnetic and electrical conditions necessary to carry the load. The increased stator current is accompanied by an increased stator copper loss to which is added a slight increase in rotor copper loss because of the increased value of the slip. The reduction in voltage lowers all values of flux densities which means a slight decrease in iron losses and a subsequent increase in power factor of about 1 percent. The sum of the increase in stator and

rotor copper losses is greater than the decrease in iron losses, and this results in a decrease in efficiency of about 2 percent. As explained before, to maintain a magnetic and electrical balance, there must be an increase of about 11 percent in stator current to offset the 10 percent loss in voltage and one percent loss in the product of power factor and efficiency. With the stator current increasing 11 percent, the stator copper losses increase approximately 22 percent. The rotor losses increase approximately 3 percent.

The reactance or impedance limits the inrush or starting current to a value proportional to the voltage. A 10 percent decrease in voltage would then result in a 10 percent decrease in starting current. As explained above, the starting and pull-out torques vary as the square of the change in voltage, so that a 10 percent decrease in voltage reduces the starting and pull-out torques 20 percent.

Over-Frequency

On present day 60 cycle systems, seldom will there be any large variation in frequency, but in many instances it is convenient to operate a 50 cycle motor on 60 cycles. A knowledge of the change in operating characteristics, due to a change in frequency, is very useful when equipment must be adapted another design frequency.

For a given motor, the speed is directly proportional to the change in frequency. Increasing the frequency 10 percent will increase the speed 10

percent and increasing the speed any appreciable amount will increase the friction and windage losses.

The reactance of the motor is directly affected by the frequency, i.e., increasing the frequency 10 percent, increases the reactance 10 percent, and the increased reactance means a decreased starting current of about 10 percent. The pull-out current is affected in a similar way. With a 10 percent decrease in flux and a 10 percent decrease in starting and pull-out currents, the starting and pull-out torques are respectively decreased 20 percent each. Generally, it can be stated that *the starting and pull-out torques vary inversely as the square of the change in frequency*.

For a given voltage input, the flux varies inversely as the frequency, i.e., if the frequency increases, the flux decreases, if the frequency decreases, the flux increases. The lower flux values call for a smaller magnetizing current, lower iron losses, and subsequent larger values of power factor. With constant load, the full load stator current will not change appreciably, and therefore, the stator copper losses will remain constant. The slip will not be greatly affected and the rotor losses will not change. The increase in friction and windage is offset by the decrease in iron losses so that generally, there is a slight gain in efficiency to be expected.

Under-Frequency

Decreasing the frequency 10 percent decreases the speed 10 percent. The

friction and windage losses are also decreased. As mentioned above, the reactance is directly proportional to the frequency. A 10 percent decrease in frequency means a 10 percent decrease in reactance and, for constant voltage, a 10 percent decrease in reactance means a 10 percent increase in starting current. The pull-out current is affected similarly. The combination of a 10 percent increase in flux and a 10 percent increase in the starting and pull-out currents brings about a 20 percent increase in starting or pull-out torques respectively.

For a given voltage input, a 10 percent decrease in frequency results in a 10 percent increase in the flux. The increased flux calls for an increase in magnetizing current, increased iron losses, and a corresponding decrease in power factor. With constant load, the full load stator current will not change greatly, therefore, the stator copper losses will remain about the same as for normal operation. Since the slip will not change appreciably, the rotor losses will remain practically constant. The net exchange of increased iron losses and decreased friction and windage losses effect a small loss in efficiency.

Generally, except for corresponding changes in speed, *the effects of over-voltage can be offset by increasing the frequency by the same amount, and the effects of under-voltage can be offset by decreasing the frequency a like amount.*

The effects of varying either voltage or frequency are tabulated in Table 1, and are shown graphically in Figs. 1 and 2. Summarizing, we have:

1. Starting and pull-out torques vary directly as the square of the change in voltage and inversely as the square of the change in frequency.
2. The speed varies directly as the change in frequency and is little affected by any change in voltage.
3. Efficiency and power factor are not greatly affected by a 10 percent change in either voltage or frequency.
4. Except for the change in speed, an increase in voltage is offset by an equal increase in frequency, and a decrease in voltage is offset by an equal decrease in frequency.
5. The starting current varies directly as the change in voltage and inversely as the change in frequency. The same is true of the pull-out current.

Voltage or frequency changes of less than 10 percent affect the operation proportionally, and can be read from the above curves.

UNDERSTANDING THE ELECTRIC METER

A. F. Stilson

PERHAPS the few following facts about the electric watt-hour meter may be of service to the maintenance man or the electrician who has not made a special study of it.

Speaking practically, the electric meter is a motor that runs at a speed in proportion to the current flowing through it and the voltage on the line, and operates only when current is flowing through it. It followed a process of painstaking evolution that involved the work of many men, and the facing of difficulties that took years of experiment and practice.

Meters consist primarily of a set of coils, called current coils, wound with heavy wire through which the load current flows; another coil in just a position to these current coils is called the potential coil and is connected directly across the line. The first creates a magnetic effect from any load current flowing through it, the second a magnetic effect from the line voltage. Acting together they create a shifting magnetic field which, interacting with a field produced by current induced by them in the disc, rotates the disc. The speed of the disc is held proportional to the load on the meter by the drag magnets visible on the front of the meter. Another coil or metal ring in the magnetic circuit acts to shade the torque so that it is in exact proportion to the power in the circuit, thus accounting for power factor. This latter refinement was a stumbling block to the early a-c meter makers, being finally applied accurately by Shallenberger of Westinghouse in 1895. The driving-coils act upon the back of the disc, the drag or dampening magnets on the front of it. The disc shaft through suitable gearing drives the register which integrates the kilowatt hours.

There are devices for temperature and overload compensation. The meter is adjusted at full load by moving the drag-magnets in and out; in to speed the meter, out to slow it, or in later meters, by shunting the air-gap between the magnets with an adjustable magnetic shunt. It is also adjusted, i.e., compensated for friction, at light-load, around ten percent load, by another adjustment.

Sometimes a consumer complains that his meter is creeping; he sees the disc drifting a little and at once thinks

registered. Generally, he does not know what a creeping meter is. This term applies to a meter that runs continuously with no load on it. The last is the catch, for many investigators forget to completely disconnect the load side of the meter when making an examination. All lights may be turned off, but there are many small devices such as electric clocks, stoker-timers, bell-transformers, heaters in electric refrigerators that have to be considered. The electrician must unscrew all fuses or disconnect all wiring on the load side of the meter. This side is usually plainly marked on the indoor type of meter, and on the outdoor type, pulling the switch in the house should clear the meter from the load. When the load is removed one must watch patiently for some time to see that the black spot on the disc used for testing, makes a full revolution.

In the disc are two tiny holes or slots to prevent creep. When the load is removed and if these holes are not under the driving coils the disc will move slowly until one of them is under these coils. There the magnetic action of the potential coil on the metal around the holes holds the disc at a standstill. Many people seeing this action think the meter is creeping.

Of course, meters do creep sometimes. Suppose one is actually found creeping at a rate of one revolution in 20 minutes. A modern house type meter of 15 amperes capacity, a standard three-wire rating, registers two watt-hours (not kilowatt hours) per revolution. At the above rate of creep for 24 hours a day, the meter will roll up a little over four kilowatts in thirty days. Different sizes, makes and types of meters register different quantities per revolution. This value, known as the watt-hour constant, is usually marked on the meter nameplate or meter disc.

If the meter is creeping, and all appliances are disconnected and upon disconnecting the load side completely the meter stops, it is obvious there is trouble in the wiring; grounds, shorts, perhaps apartments or offices interconnected. If the meter is creeping and there is a brown deposit on the glass, it is probably the current-coil that is damaged by overload or lightning. The disc may creep either way.

DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

M-10

Maintenance Check Chart for Electrical Equipment

MOTORS

✓ Keep the Windings, Ventilating Ducts, Commutators and Brush Rigging Clean

In dusty locations, blow out weekly; under severe conditions, daily. Do not use air pressure higher than 50 lbs.

✓ Lubricate Regularly, Carefully

Follow manufacturer's instructions. Oil daily those motors that require it. Schedule definite oiling dates for the others. In dusty or damp locations, drain oil once a month and renew. Do not over-lubricate. It wastes oil, gets in windings and deteriorates insulation.

✓ Examine Bearings

Check daily on heavily used motors; once a week on others. Check oil ring. Feel for high temperatures. Check for excessive end play.

✓ Check Air Gap between the Rotor and the Stator

Check weekly on motors that operate with excessive belt tension; others, once a month. Differences in width of gap indicate bearing wear which, once started, accelerates rapidly.

✓ Inspect Brushes and Commutators

Check daily on those motors in severe service; others once a week. Keep commutators smooth, with brushes seated perfectly. On carbon brushes use correct grade to prevent excessive commutator wear and control arcing.

✓ Inspect All Exposed Motor Leads

Check weekly. Keep connections tight, free from oil and moisture, well insulated and protected.

✓ Inspect Ground Connections

Check weekly. Keep tight and in good condition. THESE ARE IMPORTANT TO SAFETY of employees and, in some cases, of current protective devices.

CONTROL EQUIPMENT

Includes Magnetic Switches, Air And Oil Circuit Breakers, Controllers, Compensators, etc.

✓ Keep Control Equipment Clean

Once a week, clean and blow out dirt and dust from starting switches, compensators and air circuit breakers. Under unusually clean conditions, clean out quarterly or semiannually. Keep dirt and dust off high voltage bushings and terminals.

✓ Keep Contacts Smooth

Inspect heavily used equipment weekly; others once a month. File burned contacts smooth or replace. DO NOT LUBRICATE CONTACT SURFACES.

✓ Replace Worn Parts

Under severe conditions examine all equipment monthly and replace all worn or burned parts; under normal conditions, semiannually. Keep adjustments correct.

✓ Keep Electrical and Mechanical Connections Tight

Once a week inspect parts that vibrate. Look for loose connections, missing or loose nuts, and broken mechanical parts.

✓ Keep Oil at Proper Level and in Good Condition

Under severe conditions or in dirty or damp locations, make a monthly check of oil condition and oil level. Replace dirty or gummy oil. Keep level up to indicator.

✓ Check Overload Devices

Circuit breaker tripping points should be checked monthly. Replace dashpot oil if thick and gummy. Keep orifices in plunger clear. Keep leather bellows soft and pliable with neat's-foot oil. Be sure that heater coils for thermal overload relays are the correct size. Check overload relay settings every six months.

LIGHTNING ARRESTERS

✓ Maintain Ground Connections

Inspect in early spring before the start of the lightning season. Check the condition and resistance of ground connections. Resistance should not be over 5 ohms. A buried water main provides good ground. NEVER RUN GROUND WIRE THROUGH IRON OR STEEL PIPE UNLESS WIRE AND PIPE ARE BOUND TOGETHER.

WIRING

✓ Keep Wiring in Safe Condition

Examine monthly where vibration exists. Keep lock nuts and bushings tight on conduit, cables and other raceways. Protect wire from oil and water. Keep open wiring tight, insulated and safe from mechanical injury. Inspect all wiring once a year.

✓ Check Extensions and Drop Cords

Examine every three months where use is heavy. Check closely where wire enters socket, plug, switch, etc. Replace or repair excess wear promptly. Keep drop cords away from nails, metal hooks, etc. Keep lamp guards in place.

✓ Keep Switch, Junction, Fuse and Panel Boxes Clean and Tightly Covered

In dusty locations clean out weekly. Keep covers and unused "knockout" plugs in place. Inspect monthly.

FUSES

✓ Check Size

Twice a year inspect all fuses to determine that circuits are not overfused.

✓ Keep Fuse Clips Clean and Tight

Check connections to prevent overheating and breakdown.

✓ Maintain Refillable Type Fuses

Replace charred casings. Keep fuse assembly tight. Refill with links at the same rating as the casing.

✓ Keep Fuse and Switch Cabinets Tight

Prevent escaping sparks when fuses blow by plugging unused knockouts. Always keep doors tightly closed and secured.

TRANSFORMERS

✓ Keep Oil in Good Condition

Test annually to determine dielectric strength. If less than 18 kilovolts in standard tester, recondition oil.

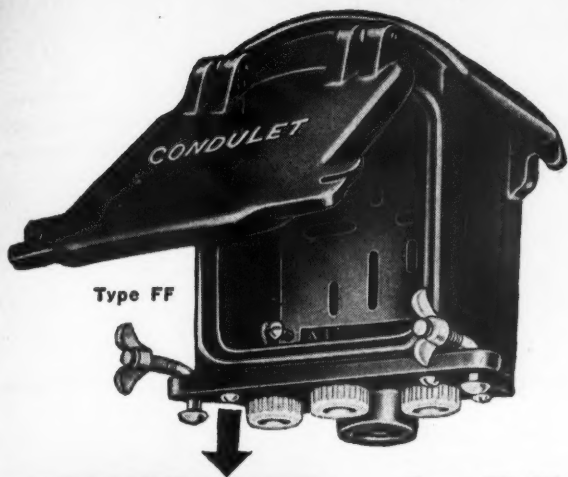
✓ Maintain Oil at Proper Level

Check oil level every three months. Replace leakage and evaporation loss promptly.

✓ Prevent Excessive Temperatures

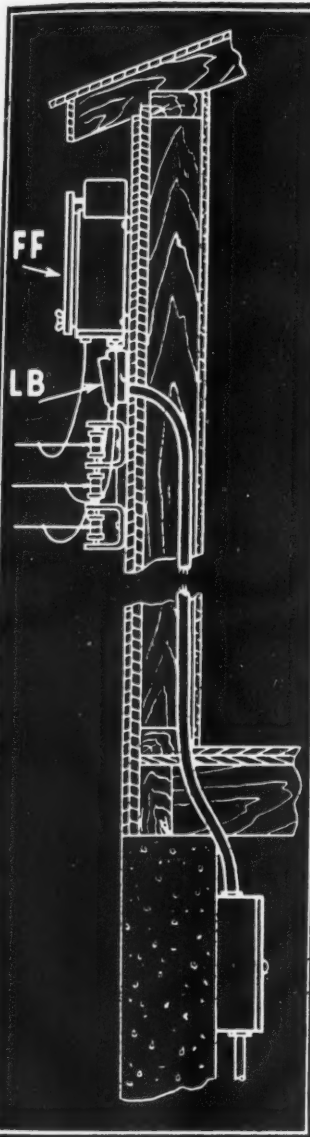
Test operating temperature of fully loaded transformer once a month. Temperature should never exceed 90°C.

Data from Westinghouse Electric Corp.



Service Entrance CONDULETS*

A type
for every
requirement



← Type FF Weatherproof Service Entrance Condulet is ideal for over-current protection. Slotted mounting plate takes standard fuse cutouts.

This Condulet meets the recommendation of the 1947 National Electrical Code which states in Section 2331 that "service entrance conductors should not be run within the hollow spacing of frame buildings unless provided with automatic over-current protection at their outer end".

Type FF is made in three sizes: 30, 60, and 100-ampere, 250 volts.

→ Type F Service Entrance Cap is made in two forms: Form 8 in sizes from 1/2 to 2-inch and Form 6 in sizes from 2-1/2 to 6-inch.

Illustrated below are other service entrance caps and fittings which may be selected from the many items listed in Crouse-Hinds Condulet Catalog.

* CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.



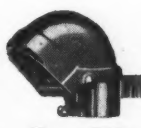
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on
small sizes



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Cap
Form 6



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Cast
Aluminum
Cable Cap



Type FED
Cable Cap



Type LB
Service
Entrance
Elbow



Type BE
Cap



Type FE
3-Part
Cap



Type FBM
Cap



Type LBC
Service
Entrance
Tee for
grounding
with driven
or buried
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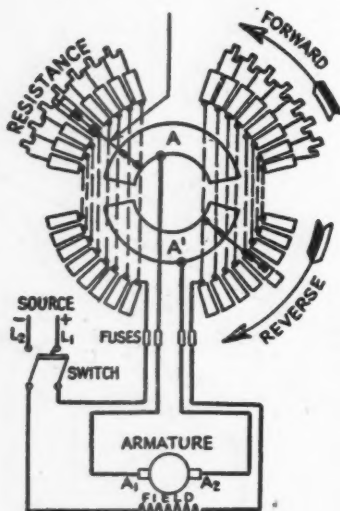
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QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay \$5.00.

Reader's Quiz

Crane Maintenance

QUESTION 276—The diagram below is of the conventional dial type d-c unit of somewhat bygone days. The resistance coils of the particular unit are located in the cast iron base and in spite of the perforated metal enclosure, the heat becomes serious in summer time operation. Not only



is the crane cab almost untenable, but the excessive heat is injurious to the resistor element and the insulation.

I would like to know if any readers have succeeded in substituting cast iron grid resistors, located at some remote distance, or have acquired the knack of brazing the element when breakage occurs.—P.C.Z.

A. TO QUESTION 276—We have not had exactly the same experience as P. C. Z., but one almost similar. Here is our method. To move the resistors elsewhere is quite practical—this we have done many times. To get back to the question. Fabricate a sheet metal box of sufficient size to hold the resistors without crowding, place this box and resistors on the outside of the crane cab, on top preferred. Use

screened ventilating slots on the sides at the bottom of the box, place a small slow speed exhaust fan in a vent at the top. This forced draft cooling system has been used many times at our installation and has always proved successful, practically always stopping the reoccurrence of resistor burnouts due to overheating.—L.R.D.

A. TO QUESTION 276—P. C. Z. seems to have encountered one of the bugbears of crane maintenance. It often happens that a crane is bought with the expectation that it will be doing duty only intermittently and so controllers and resistors with an intermittent rating are supplied. When installed, however, it gets continual usage and so the controllers and resistors are overtaxed. P. C. Z. can substitute continuous duty resistors of either the cast iron or chromel type making sure that the same ohmic values are retained. It may be to his advantage to also change over to a continuous duty controller which will require less frequent maintenance.

Fusion welding of chromel elements is practical using oxy-acetylene, but can only be done economically on the larger sizes of wire or strip, and then when the element has not been burnt by excessive heating.—S.J.H.

A. TO QUESTION 276—We have furnished many of our customers with an external resistor for this type of controller. The resistor is usually mounted on the crane walkway away from the cab.

This not only removes excessive heat from the crane cab, but also makes the controller a more efficient unit, and simplifies the maintenance.

With an external resistor, the capacity of the unit can be very greatly increased, thus insuring a very minimum of maintenance cost.—R.E.L.

A. TO QUESTION 276—Attach a reversible small size geared motor to the controller handle. Then use a reversing switch to control the pilot motor. A limit switch at each end of the reversing main controller will prevent the pilot motor from going too far.

Use resistors which can carry the load in kilowatts under the prevailing ventilating and current consuming conditions to prevent burnouts or breakage.—H.S.

Transformer Oil

QUESTION 277—Running across some "supposedly" transformer oil in unmarked containers recently, we ran a flash test on it. The "flash" test showed the oil up to standard; however, the oil did not look right or feel right, so consequently was not used. Are there any further simple tests, such as mineral or vegetable base tests, without running a complete chemical analysis, that would determine if doubtful oil is actually transformer oil, or is the "flash" test enough?—L.R.D.

A. TO QUESTION 277—Under no circumstances should oil of which there is the slightest doubt be used within a transformer. The cost of the oil is only a small fraction of the cost of the transformer, and poor oil can cause a serious failure.

Oil is used within a transformer for several reasons. In the first case, it acts as an insulator between the windings and the core, and between the windings themselves; in the second case it acts as a cooling medium, transferring the heat from the coil and core to the outside case or tubing, as the case may be.

The smallest trace of an impurity may cause insulation failure. The impurity may travel to a spot of high voltage stress and, since the impurity does not have any insulating value, may cause a dangerous arc. Again, the impurity may be corrosive and may corrode either the wire or the insulation.

The flash test by itself does not signify much. In conjunction with chemical tests it has value, but not otherwise.—H.H.S.

A. TO QUESTION 277—A quick way to indicate a mineral

OUT OF

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Roebling Parkway Cable is available with metallic armor or with a non-metallic, moisture-

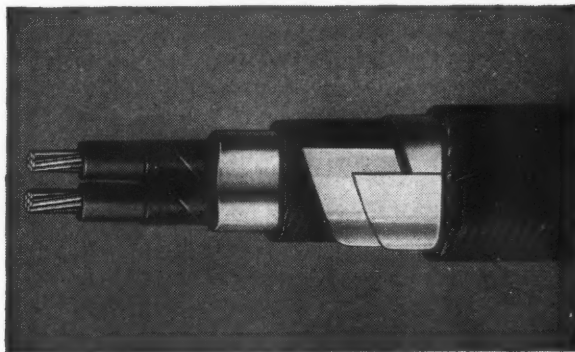
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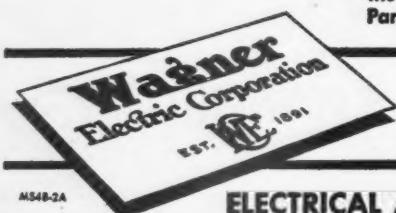
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base oil as against the others is to mix some oil and water in a small bottle and mix them. The "Fixed Oils" will readily form an emulsion whereas the Mineral Oil will separate. A more accurate method is to dissolve caustic soda in water and mix with the oil. Increase quantity until it very definitely shows that it will not create a thick or soapy substance. If the oil is of a mineral base—two layers will be in evidence—the oil base below and the caustic soda above.

I would definitely also include a test for dielectric strength as this pertains to the insulating properties of the oil—a most paramount consideration. Any Electrical Handbook outlines this simple test.

With the above information secured, you can go ahead with the use of the oil. True you have no idea of the Viscosity but if the transformer heats up after in use, you can then have reason to suspect this point.—E.A.M.

A. TO QUESTION 277—It is evident that the oil should be free from any conducting material, it should be sufficiently thin to circulate rapidly when subjected to differences of temperature at different places, and it should not be ignitable until its temperature is raised to a very high value.

A good grade of transformer oil should show very little evaporation at 100° and it should not give off gases at such a rate as to produce an explosive mixture with the surrounding air at a temperature below 180°. It should not contain moisture, acid, alkali or sulphur compounds.

Dry oil will stand an e.m.f. of 25,000 volts between two 0.5 in. knobs separated by 0.15 in. The presence of moisture can be detected by thrusting a red hot nail in the oil; if the oil "crackles" water is present. Moisture may be removed by raising the temperature slightly above the boiling point of water, but the time consumed (several days) is excessive. The oil is subsequently passed through a dry-sand filter to remove any traces of the lime or other foreign materials.

Moisture to the extent of 0.06 percent reduces the dielectric strength of the oil to about 50 percent of the value when it is free from moisture.

When checking the dielectric strength and sludging (carbonization), it should be kept at a value of 22 kv. when tested in accordance with A.S.T.M. recommendations. Minimum should be regarded as 18 kv. If lower values are obtained, the liquid should be either purified or replaced.—R.D.R.

A. TO QUESTION 277—Flash-test alone is not sufficient to determine *quality* of unknown "supposedly" transformer oil, nor will a

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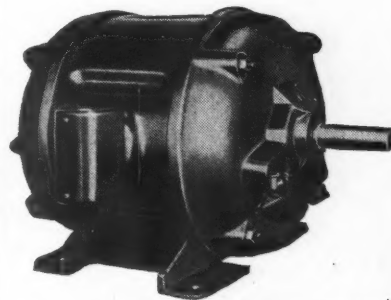
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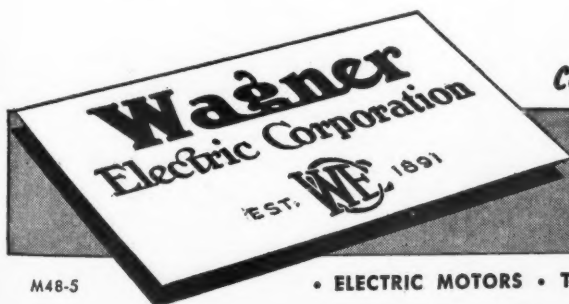
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chemical analysis, as also such analysis must be supplemented with a dielectric strength test.

L.R.D. did not indicate the quantity of transformer oil involved, as this question and factor is important, if it would warrant a complete electrical and chemical analysis, which needless to say is quite a time consuming proposition. My suggestion to L.R.D. is to disregard this supposedly transformer oil and use instead transformer oil of known brands and tested quality.

Information as to standard methods of testing transformer oil will be found in A.S.T.M. designation D 117.—C.B.

Aluminum Bus Bar Clamps

QUESTION 278—I would like to hear from readers who have had experience in the use of aluminum bus bar clamps on copper bus and vice versa. I know the code, in section 3462, prohibits the use of dissimilar metals in raceways where subject to corrosion, and I would like to know to what extent aluminum clamps can be applied to copper bus in a fairly dry substation which is, however, ventilated by opening the windows in the building.—R.M.

A. TO QUESTION 278—The formation of high-resistance oxides and sulphides is one of the main disadvantages of clamped joints. At temperatures higher than normal room temperature, this action may result in the rapid deterioration of the joint. Even a small amount of moisture or atmospheric humidity will act as an electrolyte due to its content of oxygen and various impurities. Electrolytic erosion will result resembling conditions in a voltaic cell on discharge. Aluminum becomes the negative electrode while copper or other metals such as silver and iron assume a positive potential. In dry locations, however, conditions conducive to erosion may be considered negligible.

About the simplest method of retarding or even preventing erosion in aluminum-copper joints or clampings where atmospheric conditions are favorable to erosion, is the use of a bimetallic element of aluminum and copper between the two surfaces so that copper faces copper and aluminum faces aluminum.

Clamps ordinarily used are of the 2-, 3-, and 4-bolt types. The uniformity of pressure between the surfaces in contact, as the bolts are tightened, depends largely on the rigid-

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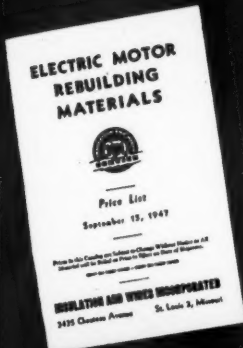
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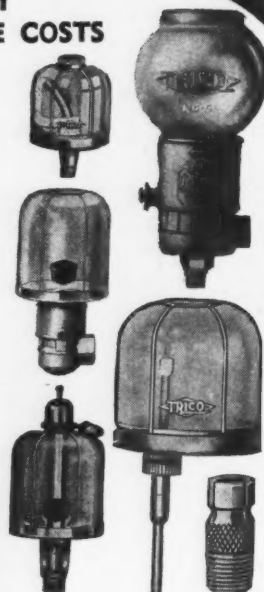
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In Canada: IRVING SMITH LIMITED, Montreal



ity of the clamps and the location of the bolts. The use of clamp bolts of ferrous material should be avoided especially on a-c circuits and in locations where the operating and ambient temperatures are subject to wide fluctuations. The loosening or overtightening of a clamped joint resulting from unequal coefficients of thermal expansion may be overcome by using bolts of material with similar thermal characteristics to copper and aluminum.

A uniform contact pressure of not less than 1000 lbs. per sq. in. should be obtained for a good joint by selecting a clamp of suitable area, adequate number of bolts, and tension per bolt. On the other hand, the pressure must not be so high as to risk the cold deformation of the bus material or to overstrain the bolts. While a clamp should have enough body to furnish the required rigidity and present adequate surface for the dissipation of heat generated at the joint which would cause undue joint strain and oxidation, it should not be too bulky for convenient handling. Length of overlap and snugness of fitting surfaces are not the only deciding factors in securing low contact resistance and permanent joints.

Surfaces to be clamped should receive special treatment. Copper surfaces should be emery clothed level but not too smooth and covered with a thin coat of petroleum jelly before being put together. It seems that level but slightly rough surfaces pressed together result in larger number of contact areas for a given pressure. Aluminum surfaces require somewhat more care. They must first be sanded smooth, free of high-resistance oxides, lightly covered with petroleum jelly, and then wire-brushed or steel-wooled before being clamped together without removing the petroleum jelly coating. This method of surface preparation applies also to aluminum-copper joints made with inserted bimetallic elements.—R.G.C.

A. TO QUESTION 278—In the atmosphere described, there should be no trouble when making copper-to-aluminum bus connections. There is little chance in practical proportions of having galvanic action. This action can be supported only by having some form of an electrolyte solution deposited at the joint between dissimilar metals.

Section 2614 of the 1947 National Electrical Code gives permission for a variety of combinations at the grounding electrode. This would imply that under ordinary circumstances no electrolysis is experienced at connections. In locations mentioned in Section 3462, it is possible to develop conducting solutions through interaction of vapors, salts, and moisture.



A well equipped, well manned laboratory has always been a "must" in maintaining and improving Superior quality.

29 Years OF LEARNING HOW!

The high standards of quality that produced the first Superior brush 29 years ago still prevail in the large brush shown at the right and others like it. Steady research at Superior has always underscored a *learn how* which we stress heavily as the one sure door to the know how.



Ask your distributor
about Superior
Assortments

SUPERIOR CARBON PRODUCTS, INC.
9113 GEORGE AVENUE • CLEVELAND 5, OHIO

Since 1919 **SUPERIOR CARBON BRUSHES**

Announcing
The Lightest,
Easiest-to-Handle
Power Unit Made

The New **RIDGID**

Porta-Power
DRIVE



For operating
hand threaders,
cutters,
reamers

HERE'S POWER where you want it—more portable than ever before; **RIDGID** Porta-Power Drive weighs only 100 pounds. One man can carry it—a cinch for two men. Modern case of new light alloy matches top grade malleable for strength and durability.

RIDGID designed for safe, easy operation. **RIDGID** 3-jaw lathe-type scroll chuck in front; self-centering workholder in rear turns with pipe. Any 60 cycle, 110 volt electric light outlet powers it. Recessed starting switch protected against bumps; special chuck-wrench ejector removes the wrench you may forget.

No upkeep bother or expense. Sealed-in lubrication—no oil to spill. Chuck and workholder ends of drive shaft ride in oilless graphite bronze bearings. Motor bearing and reduction gear lubrication sealed in. Heavy adhesive graphite grease, that won't freeze or melt, lubricates driving gear.

See the new Porta-Power Drive at your supply house. **RIDGID** Porta-Power Drives have been exhaustively tested in factory and field. Buy at your Supply House.



Back view of Porta-Power showing self-centering workholder.



Four 1" standard pipe lengths make handy Porta-Power Drive stand.



With **RIDGID** Universal Drive Shaft, Porta-Power Drive operates geared die stocks and cutters up to 8."

RIDGID

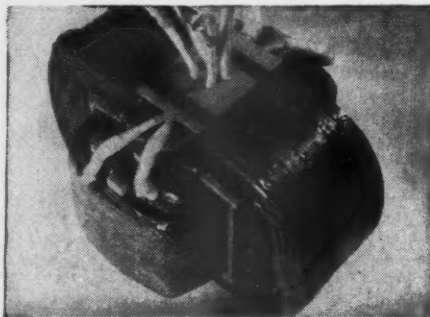
**WORK-SAVER
PIPE TOOLS**

THE RIDGE TOOL COMPANY • ELYRIA, OHIO

Silicone News



**New Silicone Insulated
3 kva transformer
SAVES 35% IN WEIGHT
TAKES 15% MORE OVERLOAD**



Core and coil assembly of DC Silicone insulated 3 kva distribution type transformer manufactured by Kuhlman Electric Co. of Bay City for Bureau of Ships, U.S. Navy.

Engineers of the Kuhlman Electric Company, working under contracts let by the Bureau of Ships, U.S.N., are using Dow Corning Silicone Insulation together with improved core steels to advance the design of dry type transformers. Size and weight of 3 kva distribution type transformers are greatly reduced without appreciable sacrifice of electrical characteristics. Core losses are actually reduced, regulation is practically unchanged as indicated by data given in the table below. These transformers also pass standard tests for dielectric strength, induced potential, and humidification.

Dow Corning Silicone Insulation offers electrical engineers unprecedented freedom in the design of similar dry type distribution or spot welding transformers as well as motors and generators. For more information write for pamphlet No. K 23-1.

	Silicone Insulated	Class B Insulated
Weight in pounds (including steel case)	48	70
Volume, cubic inches	862	1020
Losses in watts		
core	.31.4	41
total	136.4	105
Regulation in %		
100% Power Factor	3.53 (150°C. rise)	2.6 (80°C. rise)
80% Power Factor	4.35 (150°C. rise)	4.3 (80°C. rise)

**DOW CORNING CORPORATION
MIDLAND, MICHIGAN**
New York • Chicago • Cleveland • Los Angeles
Dallas • Atlanta
In Canada: Fiberglas Canada, Ltd., Toronto



Bus bar clamps of various chemical compositions have been used successfully for years in substations. Due to its magnetic properties and heating from eddy currents, iron is not used to encircle a bus carrying heavy alternating current.—L.E.B.

A. TO QUESTION 278—Ordinarily aluminum is substituted for copper bus bars, whereas you have the unusual situation of having copper bus and desire to use aluminum clamps. This is an unusual situation and effects no economy however as far as "dissimilar" metals are concerned; there still may remain a question in your mind.

Copper is anodic to aluminum. Under adverse conditions corrosion at the point of juncture may take place. There are many "two-metal" joints on the market eliminating the worry in this direction.

In your case, however, in a fairly dry substation, I would connect your aluminum clamp directly to copper bus and as much as possible waterproof the connection—over the paint use tape.

There is also on the market a preparation which when applied to the connection inhibits the formation of the oxide film which forms or at least has a tendency to form, on aluminum. Any of the connector manufacturers will supply you with this information.—E.A.M.

Can you ANSWER these QUESTIONS?

QUESTION D13—We are running 4 inch lay-in duct that will contain feeders for power and lighting circuits. The lighting circuits are switched at a panel located 200 feet from farthest lights. Could we run a large single wire the length of the duct to serve as a common return for all the lights instead of running a return line all the way to the panel for each lighting circuit?—A.S.

QUESTION E13—Can a motor with coil wound with one coil side per slot be changed to a winding of diamond coils and two coil sides per slot? This motor is 550 volts 3 phase induction motor 36 slots, 1080 rpm., 2 hp. This motor also uses basket type of winding with coils lying in slots 1-7. The coils are wound in two slots then skips two then the next two and so on around the motor. Thus, the coils span an even number of coils,—F.L.

**PLEASE SEND IN
YOUR ANSWER BY JUNE 15**

SAVE TIME

*with an Oster
"PIPE MASTER"*



Don't take OUR word for it —write for facsimile copies of letters sent to us voluntarily by owners of the Oster "PIPE MASTER". Those letters are PROOF that this modern pipe and bolt threading machine is a real investment because it's a steady profit-maker!

Standard range of the No. 502 "PIPE MASTER" is 1/4" to 2" pipe. Extra range 1/8" pipe. Equipped with special drive shaft you can thread pipe up to 6". Bolt range is 1/4" to 1 1/2".

Write for illustrated catalog "LIST 24-A".



THE OSTER MANUFACTURING CO.
2081 EAST 61st STREET
CLEVELAND 3, OHIO, U.S.A.

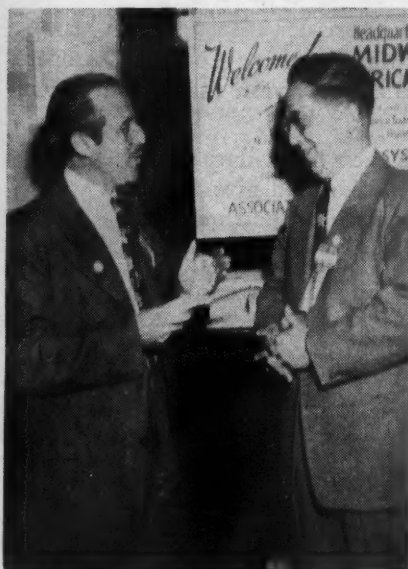
OUTDOOR SPORTS AND RECREATION LIGHTING TECHNIQUES

[FROM PAGE 88]

put approximately 35 percent with an increase of power consumption of about 16 percent, while decreasing lamp life from normal rated life by approximately 50 percent. Overvoltage operation will permit more light to be obtained with a smaller number of floodlights and related wiring, poles, controls and other equipment of that nature.

A study of the cost of maintenance of equipment including relamping, as compared with the cost of the increased number of lamps required when operated overvoltage, will indicate when such operation is economical.

Maintenance—All floodlights should be cleaned and relamped with new lamps at the beginning of each sports season, to save time and expense, and to get full value out of the power consumed. Open floodlights depreciate in light output more than twice as much as enclosed floodlights over the same period of time and use. Enclosed units are always desirable for this reason. If open units are installed, they should be cleaned monthly in smoky and dusty atmospheres. All types of lighting units should be cleaned as often as required in order to maintain the illumination value within 75 percent of initial value. Less maintenance becomes expensive, due to depreciation of light output and increase in power costs per unit for the light produced.



Retiring president of the Midwest Electrical Council, W. Arthur Starbird, Minneapolis, chats with new Council manager John Julsrud at Council booth at recent NCEI Electrical Trade Show in St. Paul.

McGILL *Levolier* SWITCHES

TRADE MARK

TRADE MARK



No. 41

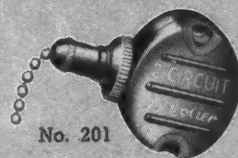
ASSURE...

POSITIVE ACTION
FROM ANY ANGLE



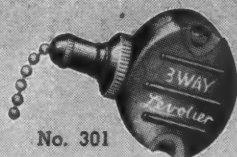
The patented universal pull lever action of LEVOLIER Switches provides instantaneous control from any angle. Their high quality, watch-like construction guarantees dependability and longer service. Specially designed sizes and types are easily applied to motors, fans, electrical appliances and lighting fixtures.

Model Number 41, shown here, is the most compact 6 amp. switch on the market today — only $\frac{5}{8}$ " thick. Particularly adaptable for canopy mounting. Qualifying for a "T" Rating by Underwriters' Laboratories, through many years service, it will safely take an initial surge of 48 amps. — eight times its rated capacity.



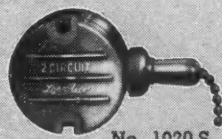
No. 201

2 circuit
3 amp.
125 volt



No. 301

3 way pull
3 amp.
125 volt



No. 1020-S

2 circuit
10 amp.
125 volt



No. 265

6 amp., 125 volt
Double pole
Double throw



A complete description of the many types and sizes of LEVOLIER Switches is found in McGILL Catalog No. 43. Send for your free copy today.

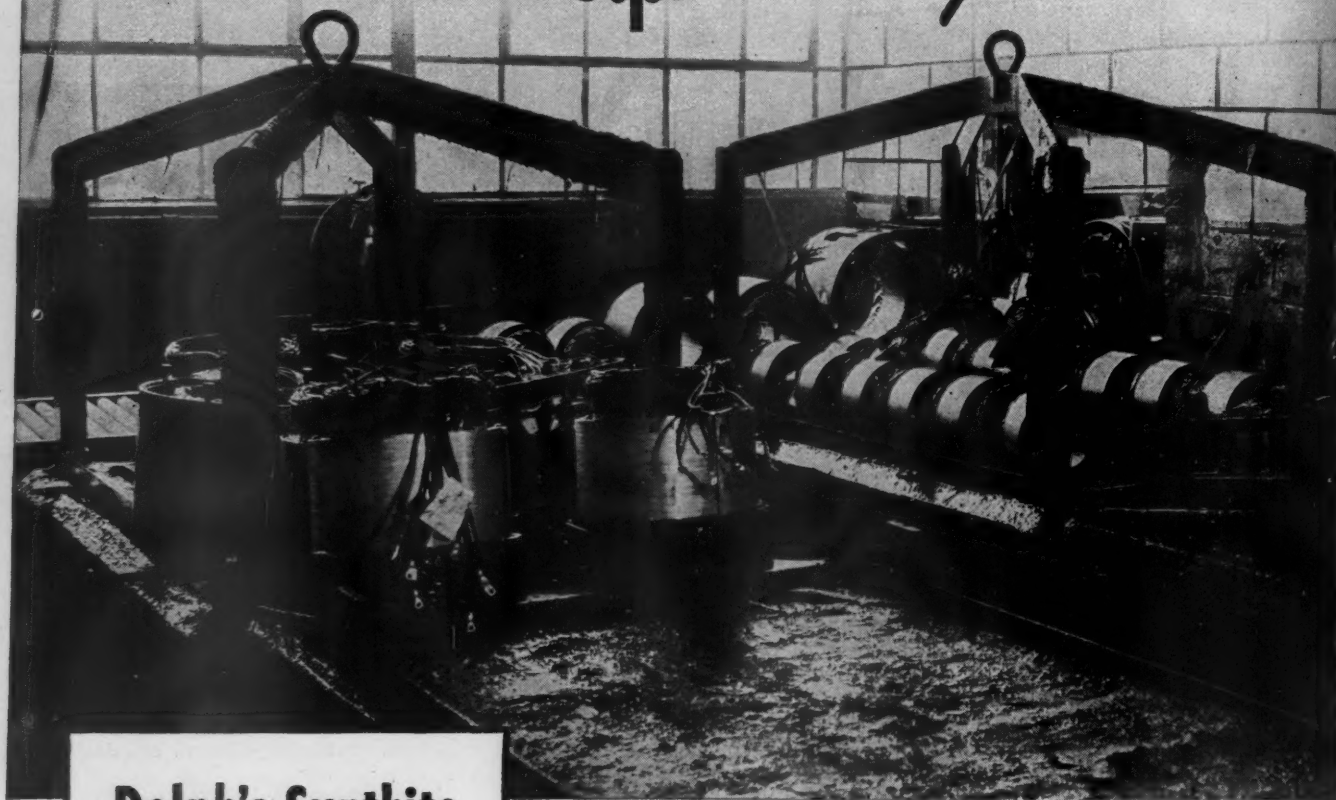
ONLY McGILL MAKES *Levolier* SWITCHES

McGILL MANUFACTURING CO., INC.
Electrical Division

450 N. Campbell Street

Valparaiso, Indiana

A Successful Project with Dolph in the picture



**Dolph's Synthite
Clear Baking
Varnish for
Deep Curing**

Stators Take Baths for Longevity

Crocker-Wheeler Electrical Manufacturing Company, Ampere, New Jersey, needed an insulating varnish that would accomplish this:

Insure long-life to their heavy-duty stators by thorough penetration and give them a permanent resistance to oil and moisture.

Dolph's Synthite Clear Baking Varnish filled the bill—and provided a plus in exceptionally high dielectric strength and good heat resistance.

Dolph's Clear Baking Varnish also gives maximum resistance to acids and alkalies—offers dielectric strength over 1800 volts per mil—and can be used on all types of electrical units, both large and small.

Why not call on our Technical Service? These men are thoroughly trained to help you plan your preheating, impregnating, draining, and baking cycle. They'll recommend the *correct* varnish for you. Meantime, write for our catalog. John C. Dolph Co., 1056 Broad St., Newark N. J.



Member Electrical Insulating Varnish Section, NEMA

I N S U L A T I N G V A R N I S H S P E C I A L I S T S

Motor Shops



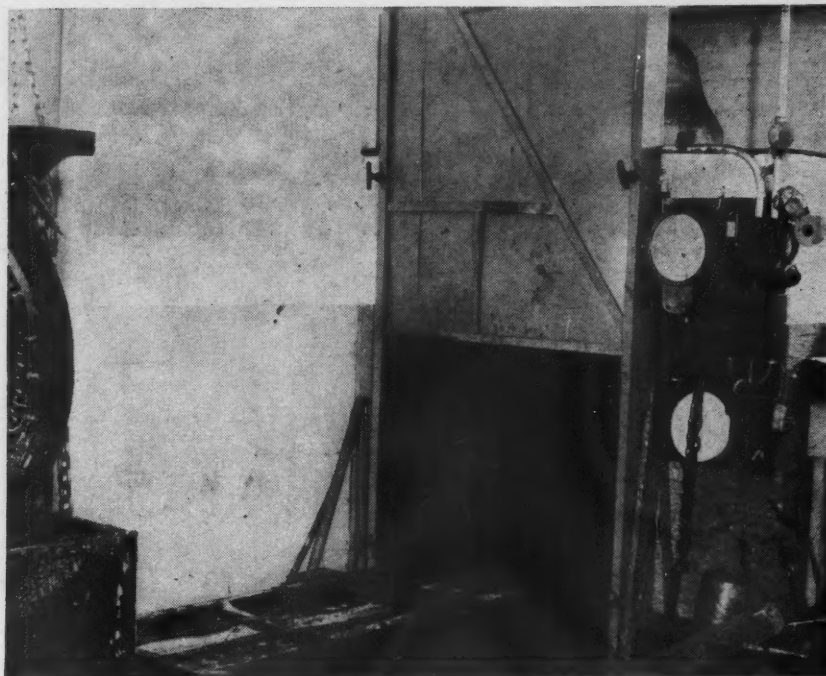
Heat exchanger in shop boiler room provides heated air under forced circulation to oven on other side of wall. Blower and automatic gas valves are shown at base of unit.

Bake Oven Uses Heat Exchanger

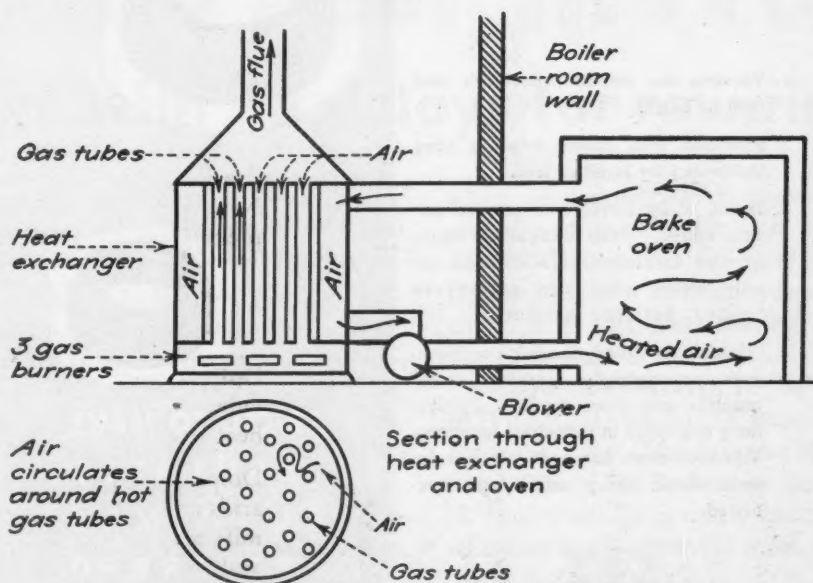
All motor shops are extremely conscious of the fire hazard present when volatile cleaning fluids and impregnating varnishes are being used. Hence the various precautions taken to have ample exhaust and ventilating systems in operation in these areas.

One of the best ways to minimize this hazard is to keep open flames away from areas where flammable or explosive mixtures might be present. It was on this premise that Lima Armature Works, Inc., Lima, Ohio, designed their new bake oven. It is a convection type unit with circulating heated air doing the actual baking. No flame is present in any part of the oven structure.

A heat exchanger, installed in an adjacent boiler room by the local gas company, does the trick. Three natural gas burners heat tubes in the exchanger. Oven air passes around these under forced circulation from a 10-inch motor driven blower in the duct system. Heated air enters the left side of the oven near the floor; leaves near the top of the oven and



No flame is present in any part of this new bake oven designed and installed by the Lima Armature Works, Inc. Circulating heated air provides baking temperatures up to 325 degrees Fahrenheit. Roll-in truck is for large motors; rack inside oven handles small items.



Cross-section of heat exchanger and oven showing heated air circulation.

returns to the exchanger for reheating. At no time does the gas flame contact the oven air.

Automatic gas and time controls regulate oven temperatures up to 325°F., also the baking cycle. A continuous temperature-time chart is provided by a recorder on the oven instru-

ment panel. Normal baking time is eight hours using Dolph No. 1503-Y varnish. Oven operating cost is approximately 11 cents per hour at the prevailing natural gas rates in the Lima area.

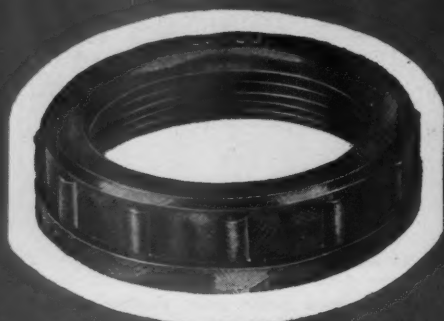
The oven itself is of brick construction; 6-ft. high, 6½-ft. deep and about

"UNION"

INSULATED

CONDUIT END

BUSHINGS



*Molded
of Impact
Resisting
Bakelite!*



1. Threads are smooth, concentric and free of burrs.
2. Provided with ribbed grip for easy tightening by hand or tool.
3. Inside of lip beveled to remove cutting edges. Thus danger of injury to wire insulation is eliminated not only when wires and cables are "pulled" but after installation.
4. "Union" Insulated Conduit-End Bushings economically prevent costly grounds and short circuits. Particularly desirable in industrial locations. Vibration often damages wire insulation where sharp edges are contacted.



UNION INSULATING CO., INC.
PARKERSBURG, WEST VIRGINIA

PRICED TO MAKE
INSULATED
BUSHINGS
PREFERRED

Compare!



Closeup of oven control panel. Note temperature-time chart that records every baking cycle.

7-ft. wide. Walk-in access is provided by a heavy insulated metal door installed off-center at the front of the oven. This unit slides vertically in a 3-inch steel channel frame; is locked into place by four heavy clamping screws. That portion of the structure protruding to the right of the door accommodates pipe racks for small motors and equipment items. Larger motors are placed on a truck whose flanged wheels ride a track flush in the shop and oven floor. This can be easily rolled in and out of the oven.

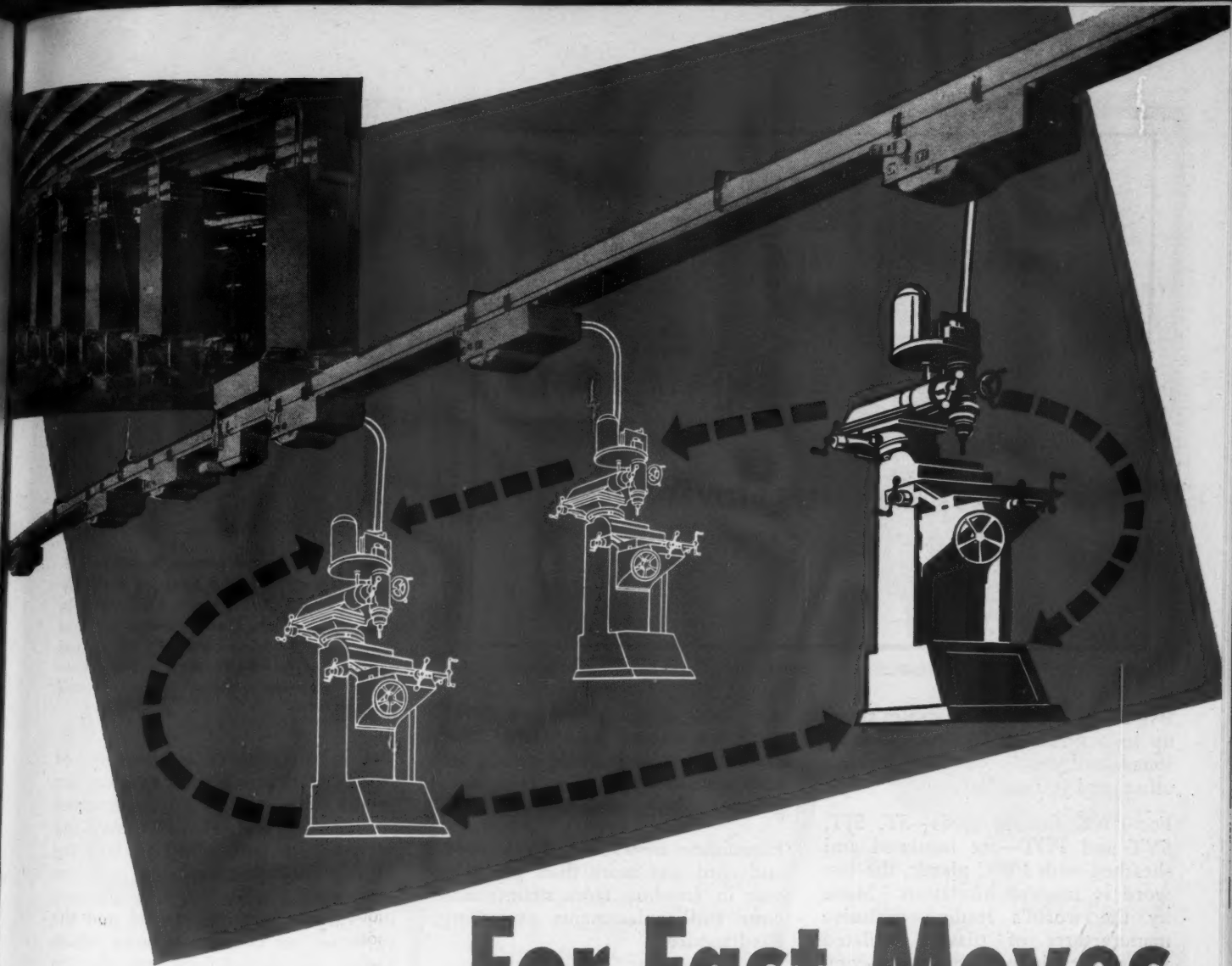
Additional advantage of this design: Lower insurance rates are possible since the heat exchanger and oven proper are separated by the boiler room wall.

Vacuum Dries Solenoid Coils

To do a more effective job of impregnating solenoid coils, Harry M. Kollus, owner of the Reliable Electric and Equipment Co., Zanesville, Ohio motor service shop, added a small vacuum system to his dipping operation. The equipment was secured from war surplus and adapted to Reliable's specific needs.

The 14-in. diameter vacuum tank is 30 inches high, has a ½-hp., 220-volt, 3-phase vacuum pump motor that can pull a 24-inch vacuum if necessary. The pump has a manually operated two-way valve. In one position a vacuum is created; in the other, a positive pressure.

Normal procedure is to preheat the solenoid coils, then place them in the



For Fast Moves

Relocate machines with no delays for rewiring

Power can be taken off wherever needed with this convenient, flexible and economical distribution system.

Power where you want it — with Trumbull FLEX-A-POWER Plug-In Busways—gives you maximum flexibility in machine arrangement without the cost and nuisance of rewiring each time you change the layout.

With FLEX-A-POWER Plug-In Busways covering your whole plant, you can

move a machine or a whole line of machines with no interruption of power. Convenient outlets every 12 inches permit plug-ins *right at the load*.

Even when major changeovers require moving an entire department, the FLEX-A-POWER system can be moved along, too — dismantled, removed and reinstalled quickly, with practically 100% use of all materials.

That's because every part of a Trumbull Busway System is prefabricated,

which of course reduces original installation and construction costs. FLEX-A-POWER is stocked in standard 10 foot lengths and is available in capacities from 250 to 1000 amp. with all necessary fittings and accessories.

Send for Bulletin. THE TRUMBULL ELECTRIC MANUFACTURING CO., Plainville, Conn. Other factories at Norwood, Ohio • San Francisco • Seattle • N. Hollywood. Sales offices and representatives in all important cities.



*The OVERHEAD
that pays for itself
in Cost Reduction*

TRUMBULL  ELECTRIC

Flex-a-Power



PWC flexible cords and cables stand up to punishment like no old-fashioned cord you've ever used, like no other cord you can buy.

For PWC flexible cords—ST, SJT, SVT and POT—are insulated and sheathed with PWC plastic, the last word in modern insulation. Made by the world's leading exclusive manufacturer of plastic insulated wire and cable, non-aging, non-combustible PWC flexible cords shrug off moisture, abrasion, oil, grease, acids and alkalis. They won't crack, fray or rot. Just try to kink them!

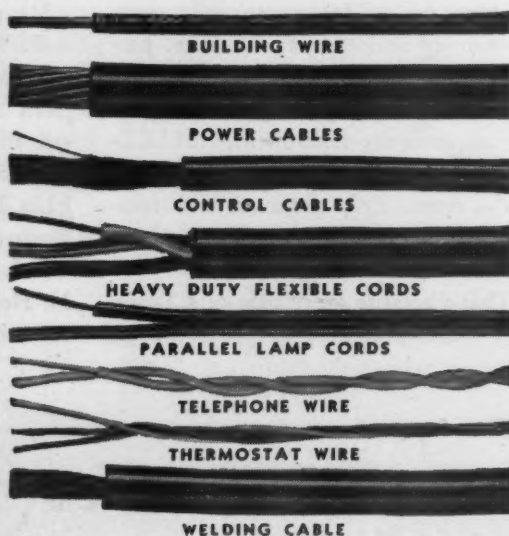
Leading manufacturers of electrical tools, major and small appliances, conveyors and other electrical prod-

ucts have standardized on PWC cords for original equipment. They are available on reels or as cord sets with molded-on plugs, receptacles or grommets, either standard or special.

Experience shows that PWC cords and cord sets more than pay their way in freedom from maintenance costs and replacements over long, hard service.

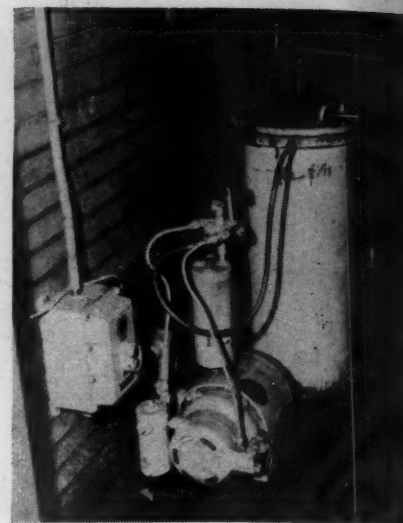
You'll get outstanding performance in every PWC product you buy—from building wire, apparatus wire, of power cable to special purpose wires and cables.

Let us quote you prices and delivery dates today.



403 EAST MAIN ST.

JEWETT CITY, CONN.



Vacuum tank and pump installed adjacent to varnish dip tank at Reliable Electric and Equipment Co. shop in Zanesville, Ohio. Unit removes air and moisture from windings of small equipment before impregnation. Note explosion-proof motor control and connections.

tank under vacuum for one-half hour or more. This forces air and moisture out of the windings. Then the vacuum is removed and varnish from the adjacent dip tank is drawn into the vacuum enclosure until the coils are submerged. After full impregnation, the vacuum pump is started and the valve set for positive pressure which forces the varnish back into the dip tank again.

The scheme has been so successful that equipment up to one horse-power in size has been placed in the tank. Plans are now under way to install a bigger tank to accommodate larger equipment.

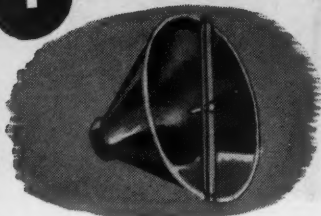
Sturdy Rack For Storage Area

Beneath the ground floor of the motor shop, which is part of the Davidson Electric Company's plant in Brooklyn, New York, is a storage area which contains an unusually large and complete stock of materials, equipment and spare parts. The capacity of the area is due to the efficient use of space, rather than to the actual cubical capacity of the vault. Storage of structural shapes, channels, angles and rods is an illustration of storing considerable material in a minimum of space.

Structural shapes are supported by tiers of racks. Racks are located against walls, extend from the floor to the reinforced-concrete ceiling, and extend into the storage area only a few inches. The main framework of the

Here's the easiest way to determine VISCOSITY...

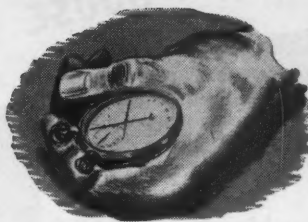
1



USE A DEMMLER CUP...

Viscosity is measured simply by placing the Demmler Viscosimeter in the varnish (or other liquid) and allowing it to settle under its own weight. Varnish enters cup through opening at the bottom.

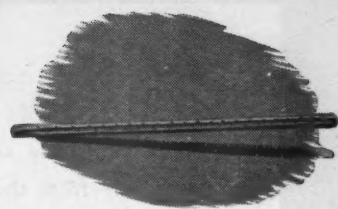
2



A STOP WATCH...

Viscosity is determined by the number of seconds elapsed from the time the tip enters the varnish, until the inflowing material touches the pointer near the top.

3



AND A THERMOMETER

A thermometer is needed to record the temperature of the varnish. Varnish viscosity varies with the temperature, and temperature variations must be adjusted to equivalent viscosity at 25°C.

Westinghouse offers a quicker, easier way to test the viscosity of electrical insulating varnishes. Using the Demmler Viscosimeter, developed by Westinghouse, operators can make the tests right in the mixing tank or varnish cans.

It consists of a cone-shaped brass cup, accurately calibrated for content and weight. A small opening in the bottom permits entry of varnish... a pointer near the top tells when to stop. It is supplied in two types, No. 1 and No. 10, both of equal size, but with differences in tip opening. No. 10 is especially for heavier liquids, and sinks ten times as rapidly as the No. 1. Available at cost (\$10.00 each).

Call or write your near-by Westinghouse distributor... to place your order or obtain more information. Also, ask for Bulletin 65-120 which gives helpful viscosity data and describes the complete line of Tuffernell Insulating Varnishes. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-06412

TUFFERNELL INSULATING VARNISHES

...for every electrical need

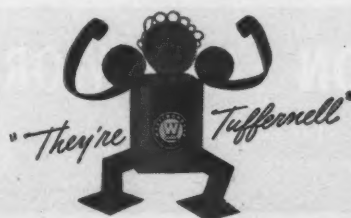
Westinghouse offers the electrical industry a complete line of insulating varnishes... a type for every requirement. Each is formulated to meet specific operating requirements... job-proved in extensive field applications... backed by the Westinghouse guarantee.

For best results, use Tuffernell!

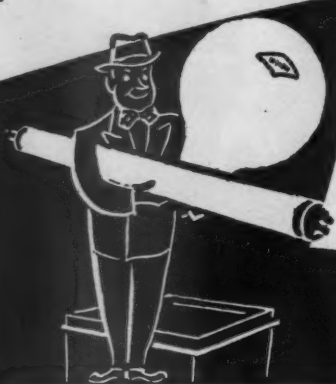


Westinghouse
PLANTS IN 25 CITIES... OFFICES EVERYWHERE

TUFFERNELL INSULATING VARNISHES



The **CHAMPION SUPPLIER**
of Lamp Bulbs and Tubes is...

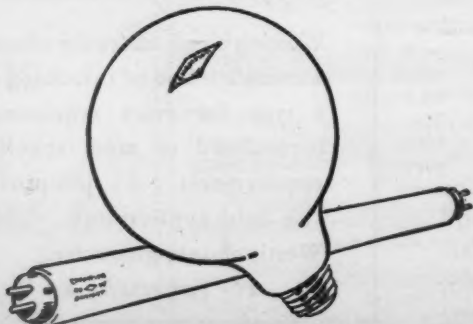


**YOUR LOCAL
ELECTRICAL OR
INDUSTRIAL
SUPPLY HOUSE**

You save time, money and trouble when you buy **CHAMPION** Fluorescent and Incandescent Lamps the same way you buy other supplies—from the house that takes care of your everyday needs.

The **CHAMPION** Lamp distributor nearest you has been selected because it is *his* business to provide prompt, intelligent industrial supply service in the same way that it is *our* business to provide high quality, long lasting, low cost industrial lamps. Champion's trained lighting experts in the field are at all times available to help you make the most of lamps and lighting.

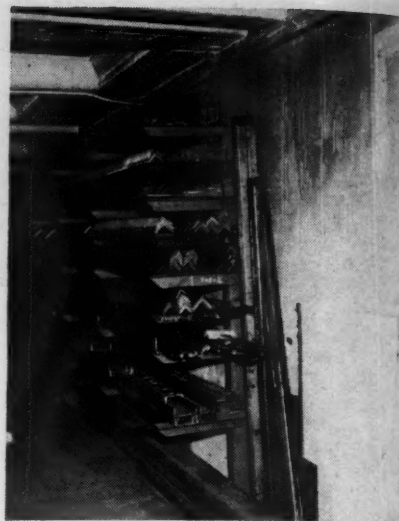
Try this easy way to get good lamps and good service. Order from your regular supply house and specify *Champion*.



CHAMPION LAMP WORKS

Lynn, Massachusetts

A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO.



Maximum storage in minimum space is accomplished in the Davidson Electric Company's motor shop by means of sturdy racks that hug the walls and take full advantage of ceiling heights. Heavy channel uprights, welded horizontal angle irons that form a bank of racks, and lips at the outer ends of the rack arms to prevent round stock from rolling are important details of the storage plan for structural shapes.

racks is composed of heavy iron channels, to which are welded 1½-inch angle irons. Angles are spaced at varying distances so that different quantities of stock can be located together at different elevations on different racks. In the case of storing round bars, angle iron lips are welded to the outside edges of the rack arms so that bars cannot roll off the racks.

Above one end of the sub-floor storage racks is a steel-plate trap door in the floor of the first-floor shop. Light structural shapes can be passed upwards through this opening while, for heavier shapes and for other material, an overhead crane can be centered over the trap door to facilitate lifting.



F. K. Hanlin, Chicago takes over as new chairman of the Illinois Chapter, **IAEI**, at recent inspector meeting in Chicago. Retiring chairman **H. C. Frieden, Moline**, is at right.

Answered by

F. N. M. SQUIRES

and

GLENN ROWELL

Chief Inspector
New York Board of Fire Underwriters
New York, N. Y.

Electrical Engineer
Fire Underwriters Inspection Bureau
Minneapolis, Minn.

Questions on the Code

Motors for Grain Elevators

Q. We are going to get R.E.A. service and a lot of the farmers want electric motors for the operation of their grain elevators, and they have to be what I call portable, don't they? Or would they be considered otherwise? Anyway, what I would like to know is how they should be protected and what to use to hook them up. To volts and use the third wire for a three pole polarized receptacle on 220 volts and use the third wire for a ground on frame of motor to neutral of electrical system, am I right?

I can't find anything on portable motors over $\frac{1}{2}$ hp. in the Code. These grain elevators would use 2 hp. or over. What type cord should be used? What type protector and what type receptacle should be used? This receptacle will likely be inside installation and if outside, it should be vapor tight. Do small $\frac{1}{4}$ hp. motors or $\frac{1}{2}$ hp. have their frame grounded to the electrical system? I maintain they should—am I right?—C.C.

A. If the motors are moved about from place to place rather than staying in one location, or if the elevators are portable ones, they could not be connected in a permanent manner, but would have to be connected by means of a portable cable. This cable should be of the heavy service type. The frames of the motors should be grounded but not to the neutral wire of the supply system. If the motors are for two or more connections and are portable, three wire cords should be used, the third wire in each case used for grounding. If a three phase motor is used, a four wire cable should be used and the fourth wire used for grounding.

If portable motors are concerned, the requirements for grounding will be found in Section 2545 of the Code. If they are not portable, see Sections 2542 and 2543. As stated above, the grounding connection should be to the grounding electrode which is used for grounding the system, such

as the water pipe or other effective ground.

If connection is made to a receptacle which is located out of doors, the receptacle should be of the weather-proof type.

If the motor is exposed to grain dusts it should be of the type specified in section 5058a.—F.N.M.S.

Water Heater Installation

Q. I have just received a rejection slip on a water heater installation made in a four flat because I did not place a single disconnect switch ahead of the four control switches. I have never before installed four electric water heaters in the same building, but I cannot see any use for this extra switch. Is this some local rule or is it part of the Underwriters Code?—P.H.

A. Probably the four flat contains four separate electrical services without a disconnect ahead and when you added the four water heaters, you exceed the maximum number of subdivisions of service permitted by Section 2351a of the N. E. Code. Under this section you will find that up to six subdivisions of service may be used when grouped at a readily accessible point nearest the point of entrance of the service conductors. Therefore, to comply with this section it would be necessary to use a disconnect switch ahead of the individual water heater switches.—G.R.

Appliance Outlets

Q. Do the appliance receptacle outlets have to be approved for 20 amperes when the appliance circuit is fused at 20 amperes or may we use ordinary duplex convenience outlets rated at 15 amperes on the appliance circuits in dwellings?—M.S.

A. You may use the ordinary duplex convenience outlet rated at 15 amperes even though the overcurrent protective device used on the circuit is rated at 20 amperes. Permission to do this will be found under Section 2123-c-3 of the N. E. Code. However, it seems advisable to provide some readily distinguishable means of identifying outlets on the special appliance circuit. Some contractors are doing this by using the three pole receptacle into which one can insert either ordinary two pole parallel blade receptacle cap or the special three pole cap.—G.R.

Knob and Tube Wiring

Q. How long are the underwriters going to permit knob and tube work in exposed locations such as basements of houses? I think for safety sake it is time to bar it.

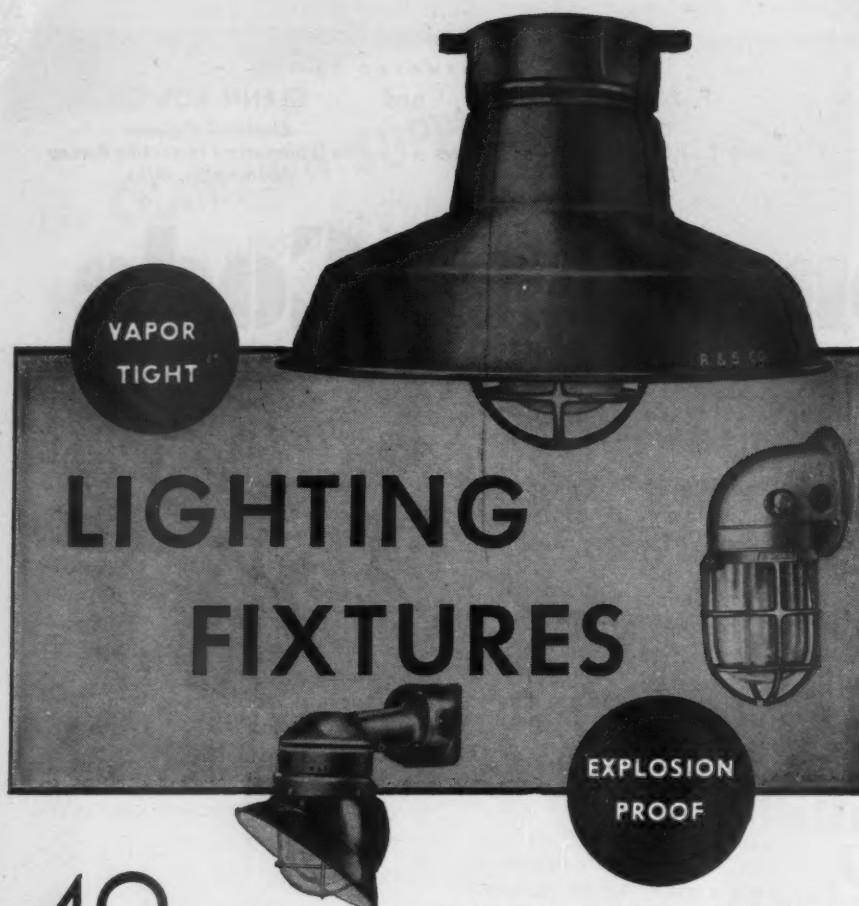
In the last two years I have been called upon to straighten up more of it than in any five years previous. I find that inexperienced persons will tap onto any wire just so they get a receptacle or light to work. Soon the circuit is overloaded and wires are hot.

I just came from a job on which a poor tap had been made and it had been arcing. This would have set the tape on fire and followed the insulation to the wood. Luckily, it burned loose before this happened.

I think it is time metal construction should be required in exposed locations. I find that with Romex they will cut into the cable also.

No matter how well the job is installed, someone will come along and in putting in additions will bungle the job.—J.M.M.

A. The trouble is not with the "underwriters" who "permit knob and tube work" nor with the rules which govern this work, but with those who "bungle the job" either in installing electric wiring in the first place or those who come along and put



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in additions in an improper manner. It is not the use but the abuse of the wiring. Please note that the proper Code name of knob-and-tube wiring is "Concealed Knob-and-Tube Wiring." (See Article 324).

Section 3242 states that "concealed knob-and-tube work may be used in the hollow spaces of walls and ceilings." This means that it should be concealed and not left exposed where subject to mechanical injury or where inviting to tampering.

If the wires are run in the basement ceiling and are not concealed, they become "open work" and should be installed in accordance with Article 320. These rules require that open wires within seven feet of the floor be considered as exposed to mechanical injury and therefore must be protected against such mechanical injury.

Remember, please, that the Code must expect that electrical wiring will be installed by competent electricians and not by inexperienced persons. The Code is not a text book to teach the inexperienced as is stated in the second sentence of the third paragraph of the stated "Purpose and Scope" in the Introduction page 6 of the Code.—F.N.M.S.

Controls for Motors

Q. What does the Code require in the way of running protection for oil burner motors? Under Section 4322-C-3 it seems to indicate that if the motor is part of an approved assembly consisting of approved controls to be used with a particular burner, no running protection is required when supplied by a 15 ampere circuit. The term "Approved Assembly" enters into the discussion also as to what determines such an assembly. Some inspectors interpret this as an oil burner and its controls approved as a unit, while others agree that it includes an approved burner with approved controls assembled on the job.—L.C.

A. A motor of one horsepower or less when part of an approved assembly so designed that the motor cannot be subject to overloads which might cause destruction of the motor windings need not be provided with individual running protection. An oil burner motor operating the oil pump and blower fan when part of an approved assembly is protected by a safety combustion control which will automatically shut off the supply of current to the motor within two minutes should an ignition or flame failure occur. The approval label of the Underwriters' Laboratories is definite



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assurance that the oil burner may be considered an approved assembly. Then in some of the larger cities the city itself may see fit to approve oil burning equipment, and in such cases that approval would indicate that the device was an approved assembly.

The N. E. Code definition of approved equipment simply reads: "Acceptable to the authority enforcing this Code". Complete oil burning furnaces of the warm air type have a second motor operating the air circulating fan and this motor must be provided with running protection regardless of the rating of the overcurrent devices protecting the circuit supplying the motor. —G.R.

Service and Meter Sequence

Q. It has become of appreciable importance to us to install indoor type meters on the supply side of entrance switches. This complies with Art. 2375, Sec. "e", of the Code, and at the same time lengthens the entrance conductors, which is restricted in Art. 2351, Sec. "a". This article reads in part, "disconnecting means should be . . . located at a readily accessible point nearest to entrance of conductors." Does this imply that meters, may be placed on the line side of disconnecting means, only if the meter is installed on the outside of the building?

Several different opinions on this matter have prompted us to ask for an explanation as to how much, if any, the fire hazard will be increased by this type of meter installation.—R.R.

A. The National Electrical Code, in section 2352 states, in part, that meters may be placed on the supply side of service switches, and in section 2375, sub-paragraph "e" states that meters may be placed on the supply side of service fuses.

This certainly means that the meters may be placed on the supply side of service equipments, and nowhere is it stated that the meters have to be outside of the building, so the meters may be either inside or outside.

Placing the meters inside of the buildings and on the supply side of the service equipments does not unduly lengthen the runs of service conductors nor has it been found by past experience that such practice has increased the fire hazards.

It has become quite general practice in many locations to install the meters on the supply side of service equipments and in most cases to put the meters on the outside of the buildings.

This was occasioned largely by the desires of the lighting companies to minimize pilfering, also to make more convenient the reading of meters which results also in greater convenience to the customers in not having the meter readers tramping through the houses.
—F.N.M.S.

Control Room

Q. When designing a control room for use in a grain elevator in order that ordinary switching and distribution equipment might be used, what is required in the way of room construction to conform to the Code?—M.C.K.

A. This question may be answered differently in some areas as there is nothing within the N. E. Code which specifies just what the standards are for a dust free room. Presuming you are concerned only with other than high voltage currents, I would recommend that the room be constructed against an outside wall if possible. If the elevator is of masonry construction, the walls of the room should be of similar construction. If the elevator is combustible, matched lumber might be used. In either case the walls should be sufficiently tight to keep the dust out. The door should be of the self-closing type and if possible the room should be kept under a very slight pressure by means of an inexpensive fan arranged to blow fresh air into the room. The amount and type of electrical equipment contained within such a room will, of course, govern the capacity of the fan required as during warm weather it may be necessary to dissipate heat given off by the electrical installation. Slight pressures will lengthen the life of control equipment provided the air supply is free of foreign material.—G.R.

Code Inquiries

Q. Will you please send me some information on the code for house and garage wiring?—E.H.B.

A. There is not, of course, sufficient space in this column to answer this inquiry. We endeavor to answer specific Code questions which are asked in order to clear up some point of the Code which may be misunderstood, but to attempt to answer such a general question as above would be beyond our scope.—F.N.M.S.



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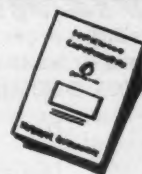


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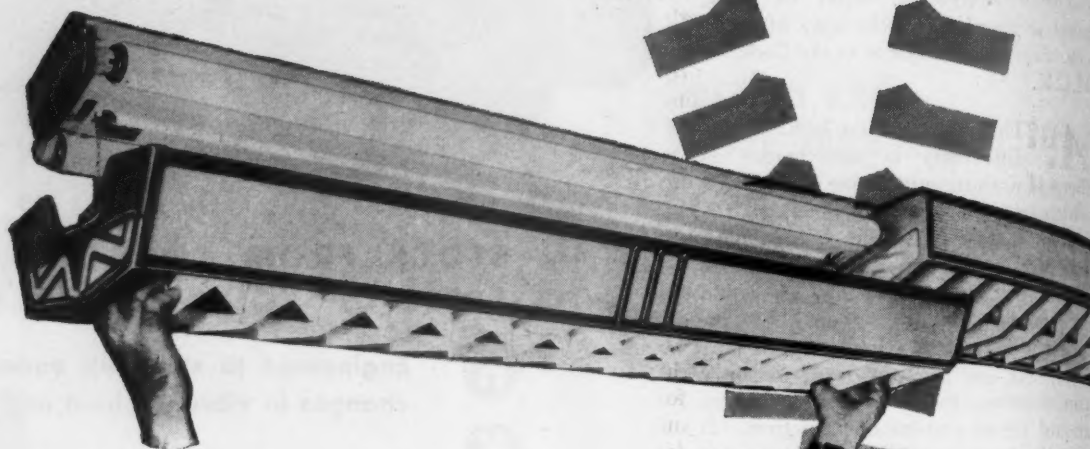
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Artificial Basement Window

In nearly every home basement is a window which provides very little daylight. It is recessed below ground-level, in a well, behind vines or shrubbery, or otherwise located so that it is impossible for daylight to get through.

An artificial window, designed by Sylvania Electric Products, Inc., presents a new and clever idea for adding charm and light to such windows. The unit consists of a shallow wooden frame containing panels of flashed opal or other types of diffusing glass or plastic, behind which are installed two fluorescent lamp strips. One strip is located across the top of this frame, and one across the bottom, of correct length to provide uniform light across the entire width of the window. The 20-watt, 24-inch lamp is proper for windows 26 to 37 inches in width, and the 30-watt, 36-inch lamp is proper for windows 38 to 49 inches in width. The back of the box may be closed with plywood, painted white inside, or with white opal glass. Use of daylight fluorescent lamps creates a very effective illusion of daylight itself. Curtains

may be thumb-tacked to small windows, or attached to small, neat curtain rods on larger size windows.

This idea is not limited to basement windows. It can also be used in attic rooms, reception rooms for offices which have no windows for daylight, in a breakfast nook, or in restaurants and other interiors having expansive blank walls where windows for natural daylight cannot be placed.

Artificial windows of this type cost very little per month to operate, yet add much charm and decorative value to an otherwise cold and drab interior.

Daylight Lamps Preferred By Workers

The full fashion nylon hosiery plant of Irvington Textile Company, Irvington, N. J., is one of the best lighted in the country, in the opinion of its management. This opinion seems to be well justified, after careful analysis of all data pertaining to this outstanding lighting installation.

This company has for some years recognized the importance of good

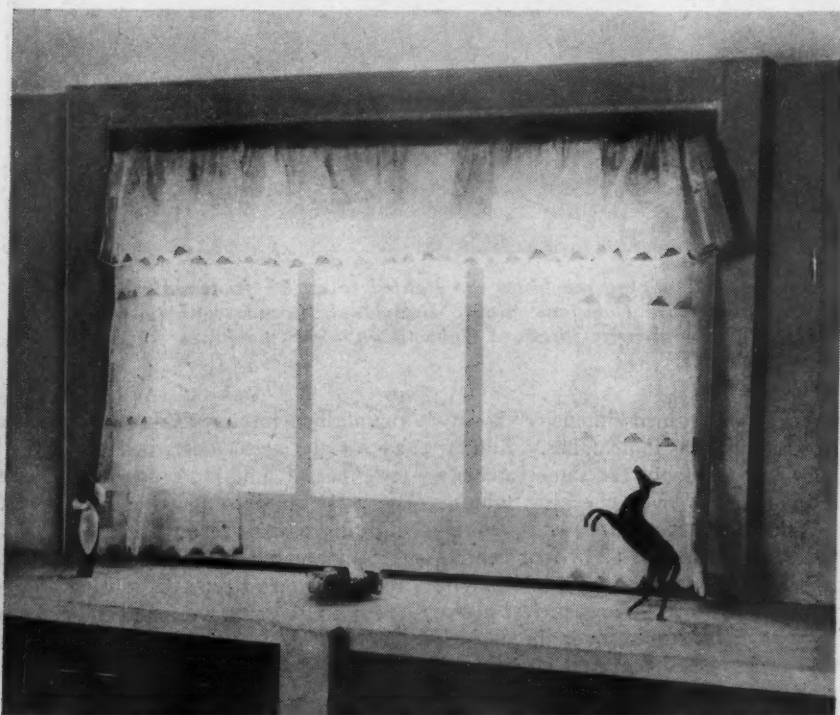
lighting in their plant. It has recognized that improved lighting will not only keep production at top efficiency, but that it also helps to maintain good employee morale.

L. A. Lefcourt, in charge of production operations, made the final decision as to the type of equipment to be used in relighting, and how it was to be installed. He did this only after making a series of tests under actual working conditions. Throughout the tests machine operators and other employees were consulted for their opinions and comments. Thus everyone is now well pleased with the finished lighting installation.

The system finally selected for lighting the full fashion knitting machines consists of continuous rows of the Miller Company's "50 Foot Candler" medium weight 2/40-watt lamp equipment, with porcelain reflectors. The continuous rows vary in length according to the length of the machines, but average 44 feet. A continuous row is mounted over the bed of each machine, and is installed six feet nine inches above the floor, or three feet ten inches above the machine bed. The rows are centered over the switch bar on the front of each knitter. A maintained intensity of 70 footcandles is obtained at needle point, the most critical point in the knitting operation. Daylight fluorescent lamps were used, after the tests, because the machine operators advised the management that they liked working under this color temperature, rather than that obtained from other types of lamps.

The same type of continuous row fluorescent fixtures are used to light the seaming and looping machines. The rows are installed five feet ten inches above the floor, and the tables on which the machines are installed are two feet seven inches high. The front edge of the reflector is mounted in line with the front edge of the machine tables. The maintained lighting intensity is 85 footcandles at machine operation level. Small incandescent spot reflectors have been installed for high intensity localized light on some of the machines, for operators who wanted more light than the 85 footcandles of general lighting, for working on dark colored materials.

Topping machines are lighted with individual 2/40 watt units mounted over each machine, at a height of five feet ten inches above the floor. The



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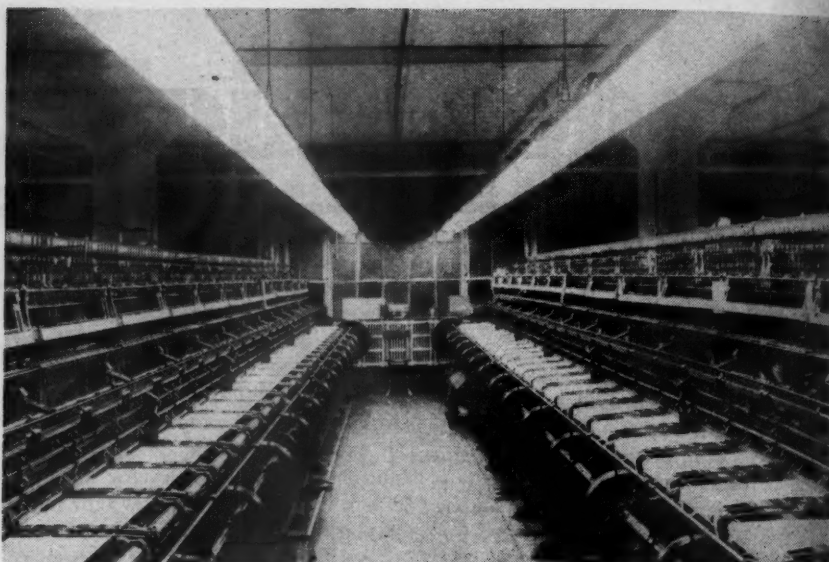
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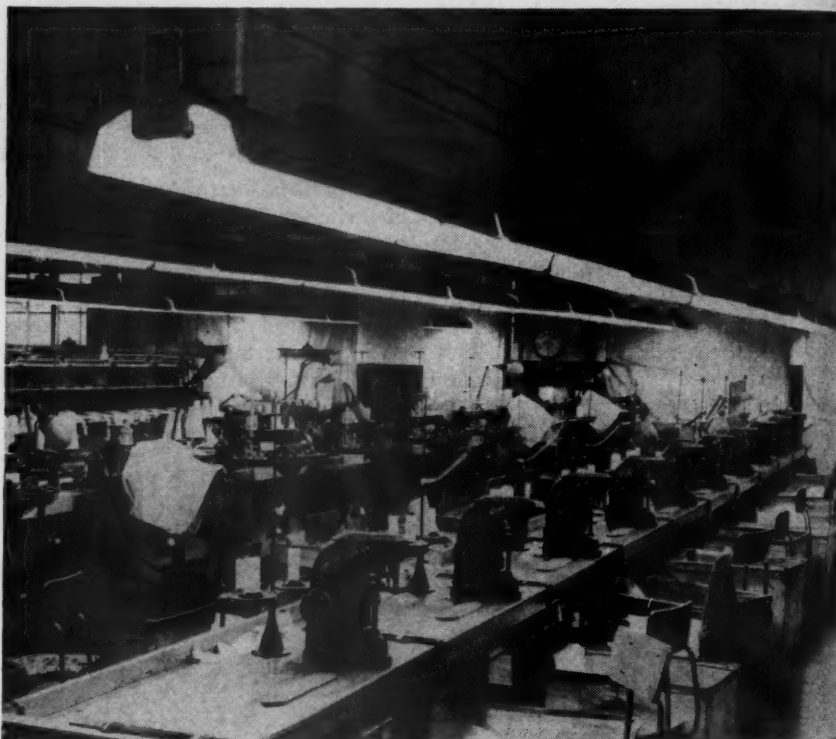
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Daylight 40-watt fluorescent lamps in Miller Company "50 Foot Candler" continuous row fixtures provide 70 footcandles on full fashion knitting machines at Irvington Textile Company, Irvington, N. J.



Seaming and looping machines are lighted to an 85 footcandle level at the Irvington Textile Company plant. Individual incandescent reflector units provide high intensity localized lighting on some machines for sewing on dark colors.

average maintained intensity is approximately 65 footcandles. Similar units provide about the same intensity of illumination over checking tables.

Continuous row 2/40-watt equipment is installed on eight-foot centers over inspection and sorting tables. The equipment is installed seven feet above the floor in this area, over the 32-inch high tables. The maintained intensity is approximately 90 footcandles.

Other departments and operations throughout the plant use similar types of lighting units, and the average

maintained intensity is about the same as for the areas described above.

Types of units and mounting details were selected to provide the desired lighting results throughout.

Cooperating with Mr. Lefcourt in the selection of type of lighting equipment and layouts were E. S. Coe, New Jersey field engineer of the Miller Company, and General Electric Supply Corporation of Newark, distributors of Miller lighting equipment. Davis Electric Company of Newark, N. J., were the electrical contractors.

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Another MITCHELL exclusive is the hinge louver. This beautifully-contoured louver frame (Model No. 340) hooks quickly onto the basic open-type fixture—swings down on patented "trunk-lock" hinge mechanism for easy relamping and cleaning. Other practical MITCHELL Slimline advantages include instant-start, no-flicker operation, longer lamp life, reduced maintenance, and handsome "new look" styling.

The basic open-type unit is available in two models: No. 3020 with 200 milliamp ballasts; No. 3020-B with 300 milliamp ballasts. Channels are all-steel, finished in white baked enamel; beautiful end-pieces are die-cast, in Satin Aluminum finish. Units may be installed singly or in continuous rows, either flush or pendant mounted.

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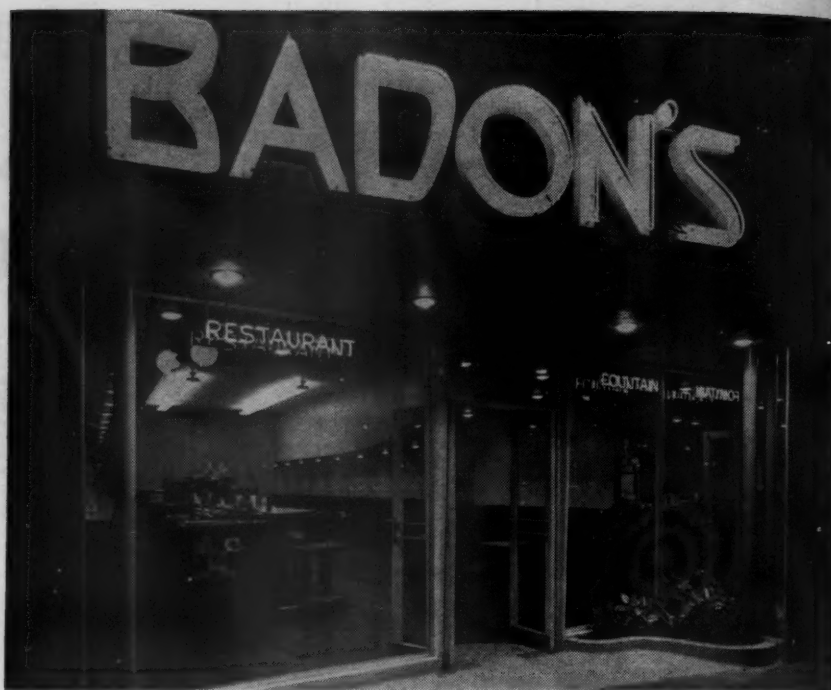
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Fluorescent surface-mounted runs of soft white, combined with incandescent spots and floods, illustrate that lighting plans need not be elaborate to be effective. Intensities from 15 to 36 footcandles are achieved with consumption of 2.5 watts per square foot.

Lighting Adds Flavor To Cafe Menus

Planned lighting and the selection of light color motifs can create an illusion of roominess in small areas. This is apparent in the dining section of Badon's Cafe in Pomona, California. Although the dimensions of the cafe are only 24 by 50 feet in floor space, light colored wallpapers, painted surfaces, counter tops and acoustical tile ceiling give the impression of a much larger area. This is furthered by the combination of fluorescent and incandescent illumination which results in from 15 to 25 footcandles on booth tables, 30 footcandles over rear tables and 36 footcandles on the fountain counter. Over the counter, two continuous rows of Wakefield Grenadier fluorescent fixtures, with five units mounted in each row, are surface mounted. Fluor-O-Shields louvre the light from the soft white lamps. To build up the footcandle intensity on specific counter working areas, 150-watt R-40 floodlamp units are recessed into the ceiling. Also recessed are the 22 Pittsburgh E-26 units with stippled lenses and 60-watt lamp which are located over the booth tables. On the sidewalk side of the all-glass front, four 150-watt R-40s are soffit mounted to illuminate the sidewalk and corner floral display adjacent to the glass surface. Surmounting the marque, white cold cathode letters spell out the name of the cafe.

The colors selected for the interior include soft yellow, aqua, rose and taupe. All are on the tinted or soft side and, with the simple yet effective lighting plan, they add greatly to the comfortable atmosphere.

Troffers Form Ceiling Pattern

The office of the Worcester Telegram and Gazette, in Worcester, Mass. has been relighted and air conditioned. The new lighting installation consists of Miller Company recessed troffers, in which two 40-watt fluorescent lamps are used above Albalite glass lenses in each four feet of trough. The troffer units have also been installed in geometric pattern, creating an unusual artistic and modern effect.

The old lighting installation consisted of 16-inch diameter enclosing glass globes suspended from the ceiling on chain hangers. Units were spaced on approximately 10-foot centers and equipped with 200-watt lamps. Sidewalls were polished marble up to a height of nine feet, which reflected the bright glass globes and caused excessive glare. Gloss paint covered the ceiling, which also reflected the direct lighting units, creating a highly confused appearance throughout. Due to the dirty condition of the ceiling and upper sidewalls, the lighting intensity averaged less than 10 footcandles.

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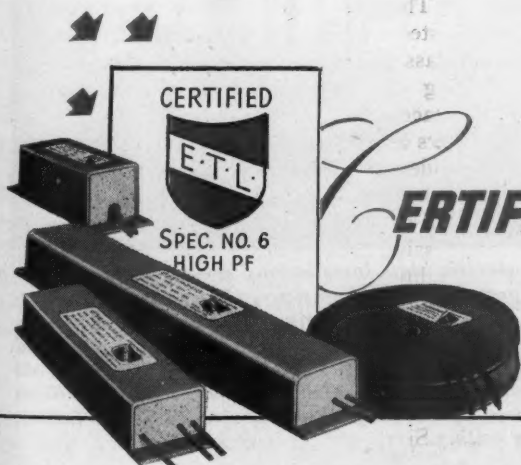
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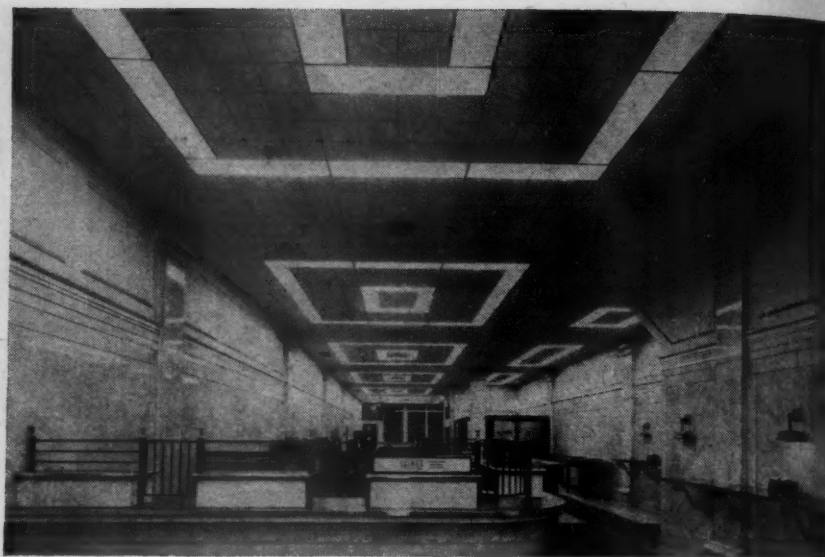
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Remodelled office of Worcester Telegram and Gazette, Worcester, Mass., includes troffer lighting laid out in geometric pattern, which provides 75 footcandles average illumination.

installed, it was desirable to put in a suspended ceiling to cover up the air ducts and beams of the old ceiling. Because of the marble walls, it was also desirable to install an acoustical ceiling, to deaden office noises. Acoustical tile was selected, and the ceiling suspended 12 feet 9 inches from the floor. This suspended ceiling provided an ideal condition for recessed lighting equipment.

The main office area was divided into bays each 22 feet long along the length of the office. In each bay two rectangular patterns were formed by troffers, one inside the other. The large rectangle was 14 feet long and 12 feet wide, outside dimensions, and con-

tained 12 four-foot sections of troffers, each equipped with two 40-watt lamps. The small rectangle was six feet long and four feet wide, outside dimensions, and contained four 4-foot sections of troffers, each equipped with two 40-watt lamps. Thus in each 22 foot long bay there were installed 16 four-foot sections of troffers, equipped with 32-40-watt lamps. The resulting intensity is approximately 75 footcandles average, or 25 footcandles per watt per square foot. Similar geometric patterns were formed with troffers in side alcoves. The resultant effect is interesting and unusual, from a decorative standpoint, as can be seen in the accompanying picture.



The luminous ceiling and electric sign installation, shown above, won a Gold Seal Merit Award for Spott Electrical Company, Oakland, Calif., electrical contractors, at the 2nd International Lighting Exposition in Chicago. A uniform intensity of more than 60 footcandles is provided for this Oakland sandwich and food shop with all-glass front. Light source is 20 mm. cold cathode tubing, spaced 18 inches on center, and operated at 60 ma. Glass panels forming ceiling are Form 66 Corning Alba-lite, size 18 by 36 inches, installed 12 inches below main ceiling.

In the News



JOHN T. DUNLOP

Appointed Arbitrator

New machinery for settling AFL jurisdictional disputes in the building and construction industry began functioning in Washington this month with John T. Dunlop, Associate Professor at Harvard University, as impartial umpire.

The procedures established for resolving intra-labor disputes without strikes or lockouts are available to any contractors employing members of the AFL building trades if they agree to abide by the terms of the agreement. Already committed to the agreement with the AFL building trades are the Associated General Contractors and seven specialty contractors, including the National Electrical Contractors Association.

New issues will be decided by a national joint board consisting of Mr. Dunlop and two representatives each from the employers and the AFL. About 30 such cases, involving use of new materials were pending, but not all are expected to reach the joint board. Some will be settled by agreement. Old jurisdictional decisions of the AFL will stand. Cases may be filed with the board by either the contractor or a union. They will be screened by a board of trustees.

The IBEW opposed the establishment of the new plan, but is committed to it with 18 other unions in the AFL building and construction trades de-

partment. The alternative to compliance is withdrawal from the building trades department and possibly the AFL.

IBEW President Dan W. Tracy opposed the plan on two grounds. (1) It will help the Taft-Hartley Law work and (2) it freezes past jurisdictional decisions which the IBEW considers unfair.

Mr. Dunlop is well known to the industry as public member of the wage adjustment board which, during the war, stabilized construction wages as an arm of the National War Labor Board. He has served as adviser to Truman's Economic Advisory Council.

The chief objective of the plan is to settle jurisdictional disputes peacefully and within the industry, thus keeping them from reaching NLRB. The Taft-Hartley Law gives NLRB authority to make arbitrary decisions which neither the contractors nor the AFL might like.

Plans Announced for Lighting Exposition

The dates for the Third National Lighting Exposition and Conference are officially set as March 29, 30, 31 and April 1, 1949, and the place is Chicago.

This action was taken at a recent meeting of the Industrial and Commercial Lighting Equipment Section of NEMA, which sponsors the Lighting Exposition and Conference.

Further action taken at the same meeting approves continuation of the Merit Award Competition, as well as the Conference Program and Exposition Plans. The Planned Lighting Merit Award Competition, which was a major feature of the 1947 Lighting Exposition, will again be held, with a total of \$1500 Gold Seal Awards and Prizes. According to R. D. Bradley, of Day-Brite Lighting, Inc., Chairman of the Merit Award Committee, booklets containing official Rules and Regulations for the Competition will be ready May 15, 1948, with the final date for entries January 15, 1949.

In announcing the new Merit Award Competition, Bradley, says, "The extraordinary interest and large number of entries of high quality in last year's contest has encouraged us to repeat this Competition with an increase in the number of Cash Prize Awards. We will offer Gold Seal Merit Awards of \$100 each to designers, planners and producers of the most meritorious lighting installations in industrial and commercial lighting. There will be separate competitions for the following



The Electrical Maintenance Engineers Association of Southern California drew an attendance of 10,500 at its three-day show held March 18-20. This was strictly an industrial electrical show, with no appliances exhibited. In all, there were 78 exhibitors using 9,300 sq.ft. of space. Formation and administration of the show were under the supervision of the E M E A executive committee—Henri Ledebour, president; Homer M. Eversz, first vice-president; William Slater, second vice-president, with last years' president; Emerson S. Richard as show manager.

Turn to KNIGHT For Smart Ways Out of Tough Spots



Elec. Contractors: Lord-Electric Co.

Harlem River Housing Project Metropolitan New York Area

KNIGHT Case History No. 1042

This New York City housing project was a triple "stumper" to challenge the modern ingenuity of electrical engineers. Shallow ceilings were erected to conserve space and house 1960 people. Construction necessitated special units for electrical wiring. KNIGHT ELECTRICAL PRODUCTS turned the key to practical solution at low cost. Knight Patented hung Ceiling Boxes with four point suspension and special mounting bars saved costly pipe bending and installation of special couplings. Extremely flexible Knight Patented Concrete Outlet Boxes reinforced concrete work and added flexibility which allows workmen to separate box halves when alterations are necessary after installation. Knight special thin wall outlet boxes allow switches and receptacles in the same position on both sides and fit two inch walls and lessen fixture needs by 50%.

This explains why economy-wise planners
turn to Knight for smart ways
out of tough spots!



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More than 40 YEARS of Service
to the Electrical Trades

ELECTRICAL PRODUCTS CORP.

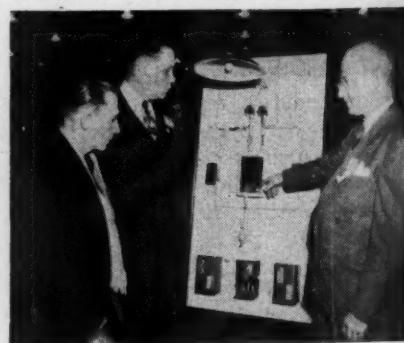
1357-63 Atlantic Ave., Brooklyn 16, N. Y.



Contractors Eugene J. Kriesel and Roy M. Reineke (center), Reineke Electric Co., Owatonna, Minn., get the low-down on electrical fittings from Al Kopald, I. A. Bennett and Co., Chicago at recent NCEI Electrical Trade Show in St. Paul.

five groups: Electrical Contractors; Utility Lighting Representatives; Architects and Consulting Engineers; Wholesaler's Lighting Specialists and Salesmen; Users of Commercial and Industrial Lighting. The competition is not open to manufacturers of lighting equipment or their employees."

G. T. Morrow, Vice-President in Charge of Sales, Curtis Lighting, Inc. who is Chairman of the Exposition Operating Committee announces its personnel, as follows: D. J. Biller, Day-Brite Lighting, Inc., Vice Chairman; S. R. Naysmith, The Miller Company; F. I. Wilson, F. W. Wakefield Brass Co.; R. W. Staud, Benjamin Electric Mfg. Co.; R. D. Bradley, Day-Brite Lighting, Inc.; V. N. Marker, Revere Electric Mfg. Co.; E. C. Huerkamp, Westinghouse Electric Corp.; W. P. Lowell, Jr., Sylvania Electric Products, Inc.; H. M. Lazer-son, Solar Light Mfg. Co.; F. J. Martin, NEMA Staff; A. B. Coffman, Exposition Manager.



Rural contractors R. E. Evans (left) Sykeston, N. D.; and N. S. Glader, Atwater, Minn., watch Cliff Davis of the M. B. Austin Company demonstrate new remote control yard lighting unit at recent trade show in St. Paul.

***These handsome
fixtures are not
pictured in Virden's
latest catalog***

They represent variations in top designs and are mentioned by number but not illustrated. Now you can see them in detail. Of course they are beauties, and of course they fit precisely into so many residential needs that you will make quick sales if you exhibit them.

Prices are as right as the designs and are a tribute to Virden's skillful mass production methods.

Your Virden distributor will be glad to supply you from stock. Available now.



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Member American Home Lighting Institute

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . MAY, 1948

GENERATE YOUR OWN

ELECTRICITY

FOR ANY PURPOSE—AT LOW COST

with a

Universal ELECTRIC PLANT

ECONOMICAL electric power is yours with a Universal. In initial cost, operation and maintenance—these properly engineered electric plants are lowest in cost.

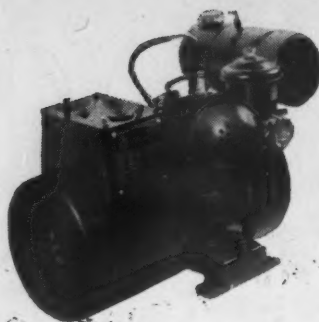
Universal offers a broad range of sizes and types—assuring a model suited exactly to your needs. There are portable, stand-by and stationary models AC or DC, from 250 to 25,000 watts—1 to 6 cylinders. There is every type of control—manual to fully automatic.

All Universals are of matched unit construction—with engine and generator exactly suited to each other... your assurance of long, reliable service.

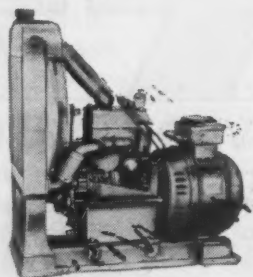


Send for Booklet, "Electricity at Low Cost" for facts and photos of Universal Electric Plants.

Contractors and Representatives! Write for full details on the profitable Universal franchise.



Lightweight, easily carried—this Universal model provides 550 watts. Electric starting. Many other portable plants, all sizes, hand-carried, dolly, trailer, etc.

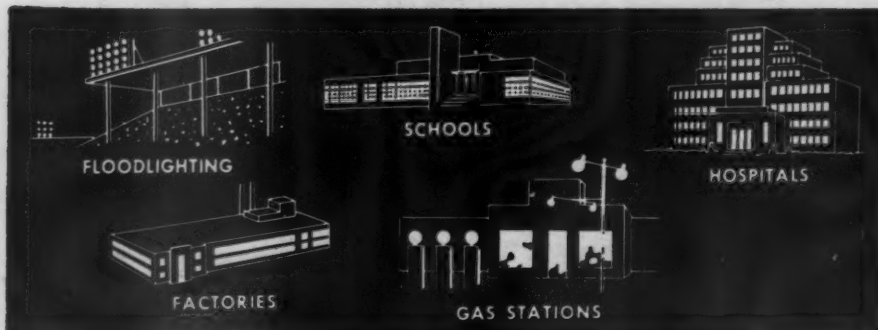


Universal 2500-3000 watt plant provides reliable, low-cost service. Powered by Universal 2-cylinder water-cooled engine. Other models to 25,000 watts.

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438 UNIVERSAL DRIVE • OSHKOSH, WISCONSIN

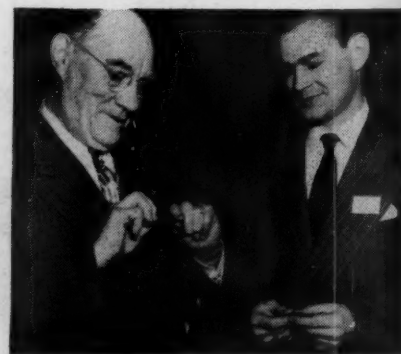


Engaged in a pre-session confab at recent NAWB Conference in Chicago are R. P. Hill (left), Arkansas Power and Light Co., Pine Bluff; and G. W. Patillo, Houston Power and Light Company, Houston, Texas

Information Headquarters for the Exposition Operating Committee are at 326 West Madison Street, Chicago 6, Illinois. All inquiries or applications for official rules of the Merit Award Competition should be sent to this address.

Fuhrman Heads Indiana NISA

Elmer E. Fuhrman, Wayne Electric Co., Ft. Wayne, Indiana, was elected chairman of the Indiana Chapter, NISA, at the recent annual meeting of that group. Other officers chosen at that time include: Vice-chairman—Frank L. Meier, Meier Electric and Machine Co., Indianapolis; secretary—J. A. Meier, Meier Electric and Machine Co., Indianapolis; treasurer—William Lohman, Capital Electric Service, Indianapolis.



Chicago's chief electrical inspector D. J. Talbot examines test connection bound with new Scotch 33 electrical insulating tape while S. P. VanArdall, Jr., Minnesota Mining Co., Chicago, watches.

*You should
have this
new book!*

This new Spero 40-page Catalog contains:

- Candlepower Distribution Curves
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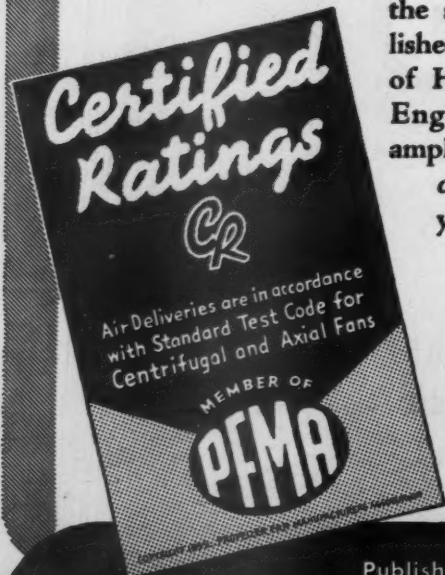


Get THE AIR YOU PAY FOR!

● You may buy an efficient-looking ventilating fan for home, commercial establishment or factory...but will it actually "deliver" in everyday operation as you hope it will?

You can be sure that you *get* the air you pay for if the propeller fan you buy and install carries a *Certified Rating Label*. The Certified Rating Label on a propeller fan means that this fan meets rigid specification standards of the Propeller Fan Manufacturers' Association, and assures you of performance in accordance with these standards.

Seventeen of the leading manufacturers of propeller fans are members of the Propeller Fan Manufacturers' Association, testing and rating their fans according to the standard test code established by the American Society of Heating and Ventilating Engineers. This gives you ample opportunity to select a *certified propeller fan* on your next purchase.



◀ **LOOK FOR the P. F. M. A. Certified Rating Label on the propeller fans you buy!**

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5-208 General Motors Building
Detroit 2, Michigan

Dryden-Harlen Opens Wisconsin Office

Newest addition to the electrical construction field in Wisconsin is the Dryden-Harlan Electric Company, recently organized to operate in the state of Wisconsin, Upper Michigan Peninsula and points west. Its major objective is to handle electrical construction on utility, major industrial and large public projects. At present the main office is in Appleton with warehouse facilities at Neenah, Wisconsin. Future plans include branch offices at Madison, Wausau and in the Upper Michigan Peninsula.

The new firm combines the technical and managerial talents of C. Lee



C. Lee Dryden, president of the new Dryden-Harlan Electric Company of Appleton, Wisconsin.

Dryden, former Manager of Central Plant Engineering, Marathon Corporation, Menasha, Wisconsin, with the engineering and construction talents and experience of the Harlan Electric Company of Detroit, Michigan. As president of the new company, Mr. Dryden, a graduate and registered electrical engineer, contributes a diversified experience in the industrial and construction field.

Previous to his Marathon connection, Mr. Dryden was chief engineer of the Signode Steel Strapping Company, Chicago; chief of staff of the Dodge Chicago Plant during the war; chief plant engineer of the American Propeller Corporation, Toledo, Ohio. His electrical construction experience embodied design and supervisory duties on such projects as the Soo Locks at Sault Ste. Marie, Michigan; the Coachella project of the Metropolitan Water District in California; the Badger Ordnance Works at Baraboo, Wisconsin; and other large projects. He

SYLVANIA GUARANTEE

"In consideration of your purchase from XYZ ELECTRICAL CONSTRUCTION CO. of a complete Sylvania packaged lighting installation consisting of 100 or more (fill in)

Number of units Type of units

Sylvania Fixtures which were installed on Mo. Day Yr. Location of installation , Sylvania

hereby guarantees that the Sylvania Fixtures listed above are free from defective materials and workmanship, and that under normal installation and operating conditions and when operated at rated voltage, they will be free from failure of fluorescent lamps, starters, ballasts, lampholders, sockets, or any other component part for a period of one year from the date of installation. Each complete Sylvania Fixture has been pre-tested in actual operation before leaving the Sylvania factory at which time it was in perfect operating condition. Damage incurred in transit or from handling is excluded from the terms of this guarantee.

"Sylvania agrees to furnish a new part in exchange for any part of these fixtures which may fail within a period of one year from the date of installation, provided you furnish full particulars within such period to any Sylvania office listed on the reverse side hereof, or your local supplier from whom you purchased these fixtures."

ELECTRIC



LIGHT BULBS; RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . MAY, 1948

No flicker! No blink! *Plus*

*COLOVOLT 10,000 HOURS Lamp Life Expectancy

These are the features you get in COLOVOLT Cold Cathode Lamps—the modern method of lighting. Pleasing, even, glare-free light with true color discrimination. No spots of greater or lesser brilliance. Low surface brightness with the lumens distributed over a longer area—the perfect light for stores, offices, buildings.

Plus THESE IMPORTANT FEATURES

+ no flicker—COLOVOLT Cold Cathode Lamps light instantly at the flip of the switch. No waiting for light. No flickering, intermittent light until warmed up for service.

+ no blink—Steady, even light at all times. No annoying on-and-off blinking after hours of service. Practically no deterioration in light throughout the entire life of the lamp.

+ 10,000 hours lamp life expectancy—four times the life of ordinary fluorescent lamps! No loss in working time. No intermediate burn-outs. No replacement of lamps during working or store hours. Lower maintenance cost.

+ attractive, modern fixtures COLOVOLT Light Fixtures are new—modern in design, pleasing in appearance, and fit into any architectural or decorative scheme. All steel construction with an exceptionally durable baked enamel finish which retains its hard, smooth, even surface and lustre. Easily cleaned. May be used with different types of diffusing glass or louvers. Union made and Underwriters' approved.

These are some of the money-saving, satisfaction-giving features of COLOVOLT Cold Cathode Lamps and Fixtures which cause them to be used in steadily mounting volume. Customers want COLOVOLT when they know about it. The trend in modern lighting is definitely to COLOVOLT Cold Cathode Lighting.

Write or wire today for complete information.



*Trade Mark Reg. U.S. Pat. Off.

GENERAL LUMINESCENT CORPORATION

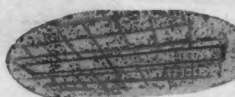
672 SOUTH FEDERAL STREET • CHICAGO 5, ILLINOIS



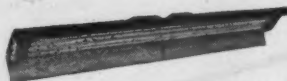
GENERALINER



SIMPLICITY



RECESSED



INDUSTRIAL



Harold Headley, Winnebago, Minn., electrical contractor seeks a bit of advice from Bill Ritt, former manager—and still secretary—of the Midwest Electrical Council at recent convention in St. Paul.

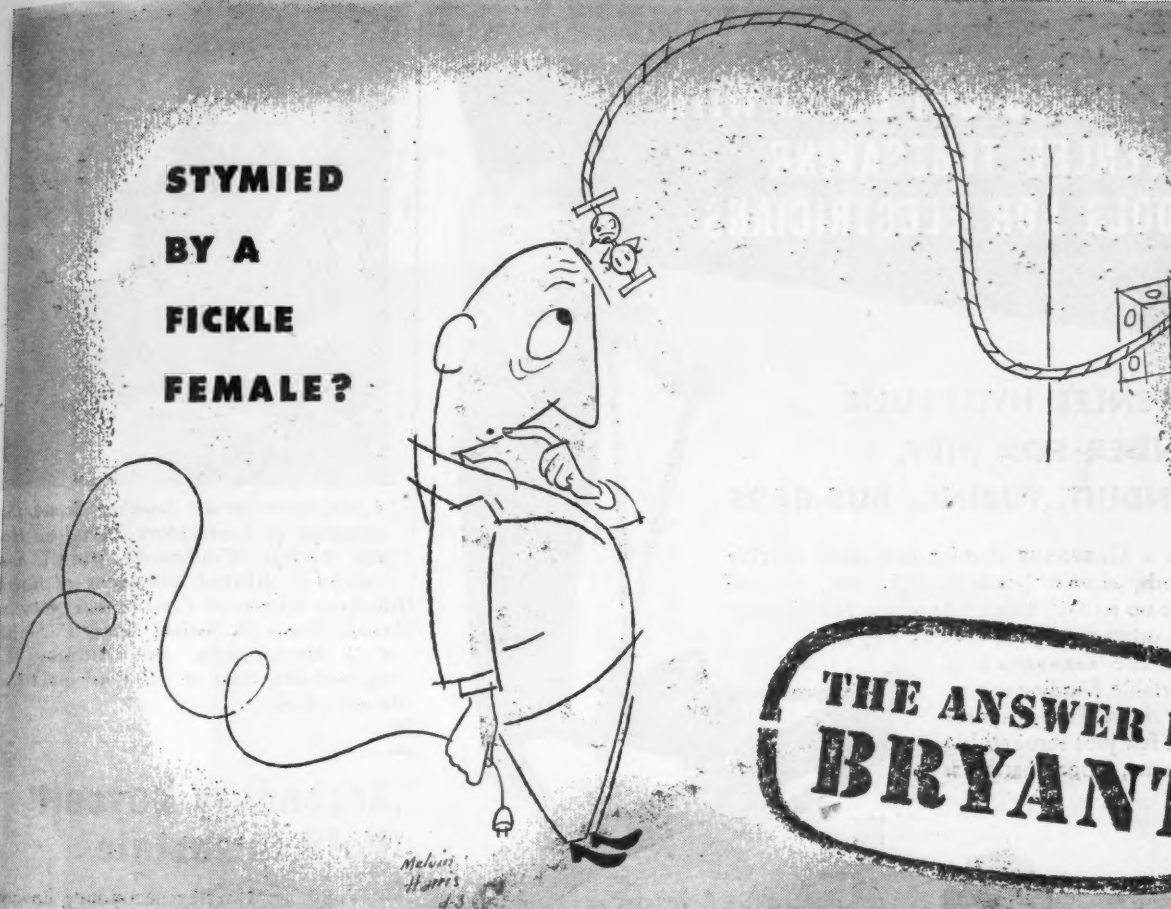
was also instructor of industrial electricity at the Henry Ford Trade School where he contributed material to Naddon and Gelmine's textbook "Industrial Electricity".

Other affiliates of the Harlan Electric Company are the Harlan Electrical Construction Company, an Ohio corporation; the Ramsey Electric Company, a Tennessee corporation; and the Lyman Electric Company, an Indiana corporation.



Electrical contractor W. P. Got of Edmonton, Alberta, Canada, finds house wiring costs have jumped 50 percent in his area. A contractor for four years, he was formerly electrical maintenance superintendent at the Swift & Company meat packing plant in Edmonton.

**STYMIED
BY A
FICKLE
FEMALE?**



**THE ANSWER IS
BRYANT**

NEW BRYANT CATALOG IS INDUSTRY'S SHOW WINDOW

Once again—Bryant gives you the answer to modern wiring device problems. It's the new 1948 Bryant catalog... featuring a most complete line of quality wiring devices.

It's complete and compact—it presents industry's broadest line of devices for every wiring need.

It's simplified—information is consolidated in logical arrangement of products by sections for quick reference and easy ordering.

It interprets—adequate wiring standards are listed in terms of Bryant catalog numbers and prepared in specification sheet form for use by architects, engineers, and contractors.

For the first time—a quick selector chart for easy identification and choice of flush plates.

Get your copy of the new 1948 Bryant catalog and see why, more than ever before, **Bryant is the answer!**



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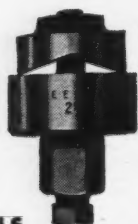
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*60th
Anniversary
1888-1948*

SAVE HOURS, CUT COSTS WITH GREENLEE TIMESAVING TOOLS FOR ELECTRICIANS

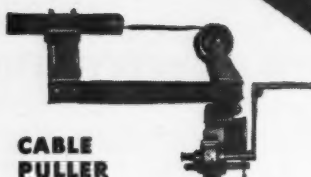
GREENLEE HYDRAULIC BENDER FOR PIPE, CONDUIT, TUBING, BUS-BARS

With a GREENLEE Bender one man quickly makes smooth, accurate bends in rigid and thin-wall conduit, pipe up to 4½", tubing, bus-bars. No kinking, wrinkling or other damage to conduit this way. And, since the GREENLEE is compact, portable, bending can be done *right on the job*. Easily pays for itself on first few jobs through big savings in time, labor, materials.



KNOCKOUT TOOLS

Eliminate tedious drilling and filing to enlarge a hole for conduit or cable. In 1½ minutes or less cut smooth openings up to 3½" in bakelite, hard rubber, or metal up to ½" thick. Turned with an ordinary wrench.



CABLE PULLER

Easy-operating, compact unit for 7,500 pound pull. Fastens direct to conduit for pulling in line with conduit . . . no loosened hangers. Attachment available for concealed conduit work.

BORING TOOLS

Designed especially for electricians to produce smooth openings in a hurry:

No. 16 Unispur Electricians' Auger Bit . . . No. 21 Solid-Center Electricians' Auger Bit . . . No. 48 Bell Hangers' Drill . . . No. 900 Bit Extension.



HAND BENDER

Quickly makes small-radius bends in steel, copper, brass and aluminum tubing, conduit, or pipe . . . without kinks or flattening. Especially designed to make neat bends up to 180° for sharp nooks and corners.



WRITE GREENLEE TOOL CO., 1745 COLUMBIA AVE., ROCKFORD, ILL.
for complete data on above equipment as well as Greenlee Joist Borers • Pipe Pushers
Expansive Bits • Spiral Screw Drivers • Automatic Push Drills and many other quality tools.



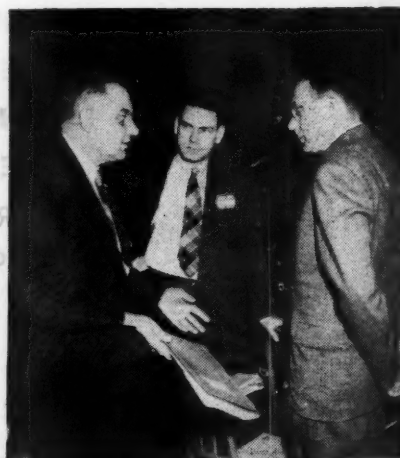
A magnetic circuit breaker draws the attention of contractors Theodore Hojem (left), Westbrook, Minn.; and George C. Hilstad, president of North Dakota Electrical Contractors Association. Bruce D. Smith, Harry P. Smith Co., Minneapolis, demonstrates the Heinemann unit at St. Paul electrical trade show.

Secondary Boycott Held Intrastate

The Taft-Hartley secondary boycott injunction sought by the National Labor Relations Board against AFL Building Trades Union in Denver, Colo., has been denied because the housing construction involved was intrastate in character and the dispute did not affect commerce.

This was the first judicial decision under the new labor law holding that housing construction did not affect interstate commerce.

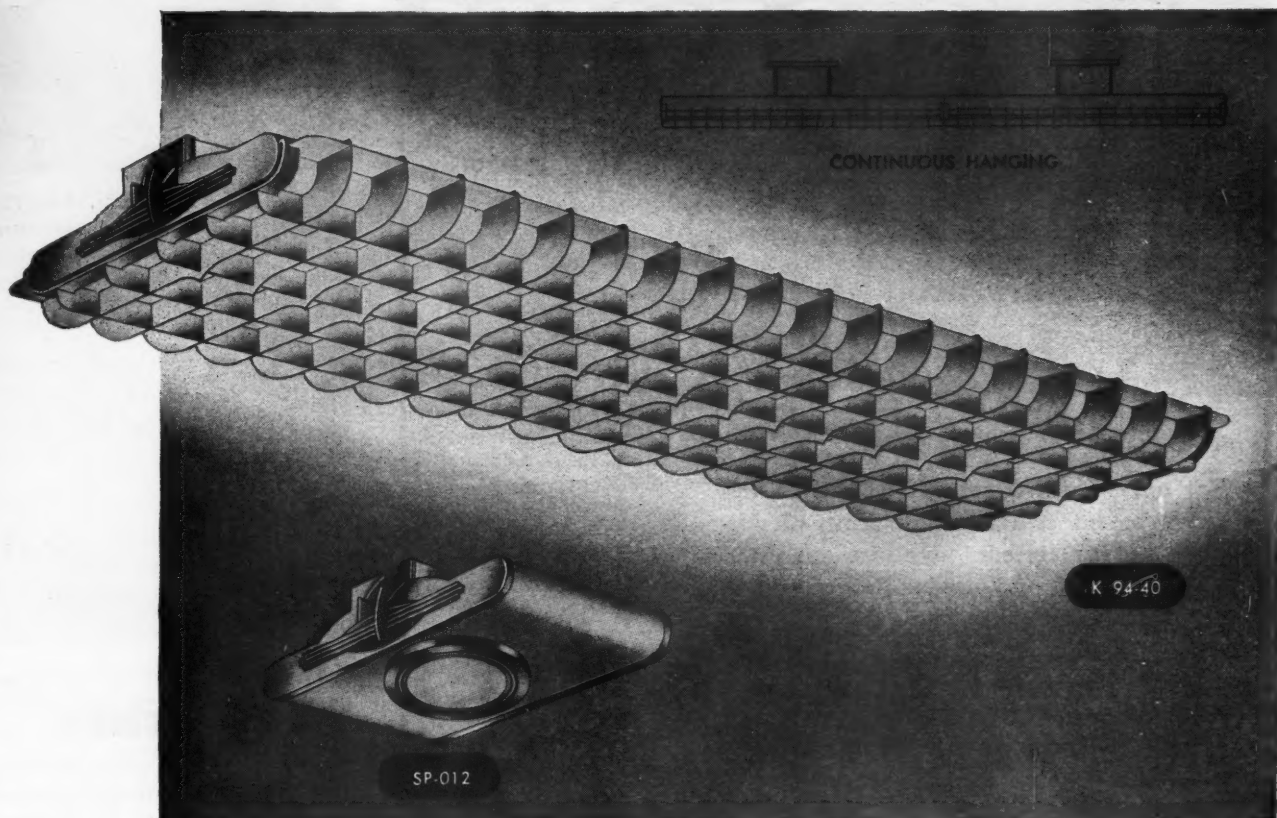
The Denver situation involved the AFL Building Trades Council and



New manager of the Minnesota Electrical Association A. Earl Anderson (left) discusses industry problems with contractors C. D. Burton, Brainerd, Minn.; and A. M. Kohler of Hibbing at recent electrical convention and trade show in St. Paul.

"FITS EVERY COMMERCIAL LIGHTING NEED"

THE *NEW* GLOBE *Economizer*



IMPORTANT FEATURES that will help you sell.

THE NEW GLOBE ECONOMIZER...an exceptional fixture made to sell on sight.

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- ✓ **MODERN SILVERTONE ENDS** - With applied modern cast metal motif
- ✓ **SPOTLIGHT** - Ring Swivel Construction: Spotlight bulb can be swiveled or adjusted to almost any desired angle.

AVAILABLE IN THE FOLLOWING...

- 4 Light Open "SLIMLITE"
- 4 Light Louvered "SLIMLITE"
- 4 Light Open "ECONOMIZER" Fluorescent
- 4 Light Louvered "ECONOMIZER" Fluorescent

WRITE TODAY for GLOBE'S Special Commercial Folder FL-42 showing these new Economizer units and also the colorful RESIDENTIAL Lighting Catalog R-48.

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TRANSFORMERS

The Latest Development in **Dry-Type** Transformers

Imitated? by others **Yes!**
 Duplicated? by others **No!**

Not only are we the **PIONEERS** in the development and manufacturing of Air-Cooled Transformers, we are also the **LEADERS** with the latest improvements and refinements.

This is our principal business

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Over 30 Years' Experience

Liberal Design
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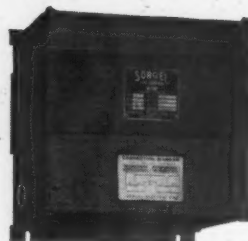
A size and type
 for every purpose.
 1/4 to 1000 Kva.
 All voltages.
 115 volts to
 15,000 volts.



1/4 KVA.
 Single Phase
 460/230 to
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100 Kva. Single Phase
 Floor Mounting Type.



3 Kva. 3-phase

SORGEI ELECTRIC CO., 836 W. National Ave., Milwaukee 4, Wis.

Pioneers in the development and manufacturing of Air-Cooled transformers.



Watching J. W. Lewin, Lew Electric Fittings Co., Chicago, demonstrate a steel tube bender at St. Paul electrical trade show are contractors E. M. Lothrop (center), Huron, S. D.; and Maurice Olson, Emmons, Minnesota.

locals of carpenters, electricians and plumbers. They had placed Gould & Preisner, electrical contractors, on the "unfair" list and picketed a housing project under construction by Doose & Lintner, general contractors. Gould & Preisner had subcontracted the installation of electric wiring and fixtures.

Elect New NISA Directors

As a result of recent balloting, five motor shop operators have been elected as new members of the National Industrial Service Association Board of Directors. They are:

Region 3 (Del., D. C., Md., Pa.)—C. R. Durand, H. N. Crowder, Jr., Co., Allentown, Pennsylvania.

Region 6 (Ala., La., Miss., Tenn.)—T. M. Russell, Russell Electric Company, Mobile, Alabama.

Region 9 (Ill., Wis.)—Joseph F.



Examining Belco shock-proof duplex receptacles at Illinois inspectors meeting in Chicago are (L to R) R. F. Diehl, Square Deal Electric Co., Rockford, Ill.; H. L. Stillman, president, Bell Electric Co., Chicago; and Rockford electrical inspectors J. T. Swanson of the city electrical department and W. M. Schoknicht of the Central Illinois Electric and Gas Company.

Ferrari, Excel Electric Service Co., Chicago, Illinois.

Region 12 (Ark., Kan., Mo., Okla.)—John E. Launder, Independent Electric Machinery Co., Kansas City, Missouri.

Region 15 (Canada)—B. C. T. Elworthy, Elworthy & Co., Ltd., Vancouver, B. C.



New president of the Minnesota Electrical Inspectors Association Harold F. Beilke (right), Rochester, Minn., chats with retiring president Harold V. Cooper, Waseca, during code session at recent electrical convention in St. Paul.

Meyer Heads Chicago Lighting Institute

A. H. Meyer was recently elected president of the Chicago Lighting Institute. A well known executive in the lamp and lighting industry, Mr. Meyer has been manager of General Electric Company's Midland sales district in Chicago for more than 30 years; has served as vice-president of the Institute for the past several years. As Institute president, he succeeds Ralph Raymond, manager of electricity sales, Commonwealth Edison Company and "father" of the Chicago Lighting Institute.

Reinke Pilots Chicago Group

George W. Reinke, G. W. Reinke Electric Company, was chosen president of the Cook County Electrical Contractors Association at the annual election of that group. Other officers

"Look, Jack, there's even an electric heater in the wall!"

They want to buy when they see extras like G.E.'s Built-in Heater!

When people (especially the ladies) are looking for houses, their eyes are open for the extra luxury features.

The little features they can show off to friends. Features that take away the objection that a certain house "costs too much," or is "too small."

And General Electric's new Built-in Wall Heater is just such a feature.

One hundred per cent practical, you can build this electric heater into any wall you please.

It's easy—takes very little time. The heater works on the radiant convection principle—heats up fast.

You can also attach a remote control switch, and turn on this heater



from another room or from the bedside. A wonderful way to warm up the bathroom without having to get out of bed.

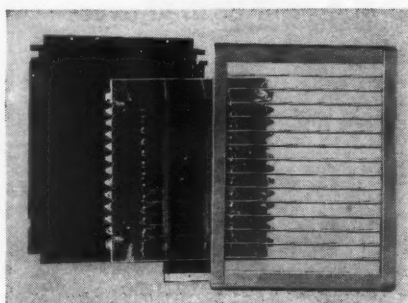
Specifications for General Electric Built-in Wall Heater . . .

1. Comes completely equipped with tumbler switch as integral part.
2. Beautiful Hammertone gray finish—can easily be painted another color.
3. Fits flush with wall—guard projects only $\frac{5}{8}$ of an inch.
4. Highly polished corrugated-aluminum reflector radiates heat in wide zone.
5. Protective grille of high-quality-steel wire—easily removed for cleaning.
6. Two long-life heating elements of nichrome wire—ceramic cords.
7. Rating—1320 watts, 115 volts, a-c/d-c, 4507 Btu per hour.
8. Size: $17\frac{1}{8}$ inches high by $13\frac{1}{8}$ inches wide by $4\frac{3}{4}$ inches deep. Wall opening, $14\frac{3}{4}$ by $11\frac{1}{2}$ inches.
9. Shipping weight, 10 pounds.

Amazingly low-priced



BUILT-IN ELECTRIC WALL HEATER



Here's how the General Electric Built-in Wall Heater is delivered to you: A wall box, heating assembly, and grille. Instructions attached to heater.

General Electric Co., Section 282-21
1285 Boston Avenue
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Please send me complete information on General Electric's Built-in Wall Heaters.

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...there **IS** something
NEW under the Sun!

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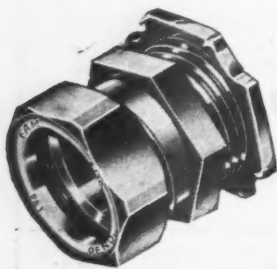


FAM Coupling
(Cutaway View)

**ALL STEEL
CADMIUM PLATED**

■ Eliminate your fitting problems from the start. The FAM coupling has only three parts—and no rings to cock or lose. It's precision machined to bite deeply into the conduit surface for sure, positive ground, and a raintight seal. And better yet, FAM couplings can be used over and over again.

FAM Connector



FAM Features

1. Simple, fast installation
2. No rings to cock or lose
3. Precision machined taper fit
4. Cuts surface for positive ground
5. Raintight—UL Approved

Buy **FAM** couplings and connectors—they will merit your continued confidence

**SOLD ONLY THROUGH
RECOGNIZED JOBBERS**

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757 Waveland Avenue
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elected include: Vice-president—Leo Witz, Continental Electrical Construction Co., Chicago; secretary—R. A. Clausen, West Town Electric Co., Cicero; treasurer—Joseph Turek, Avers Electric Co., Berwyn. Herbert Binner continues as executive secretary and manager.

On the 1948 board of directors are: Frank Block, Robert Darby, H. E. Hartmann, Victor Jensen, Erwin Kaufman, Abe Sluis, and A. A. Wohlgezon.

Building Contracts Increase

Contracts awarded for construction in the 37 states east of the Rocky Mountains during the first two months of this year topped the dollar total of awards for the corresponding months of last year by 28 per cent, according to F. W. Dodge Corporation, a fact-finding organization for the building industry.

February's awards by dollar volume were 11 percent greater than January's and 54 percent greater than those of February of last year.

The dollar valuation of contracts awarded in the first two months of this year east of the Rockies was \$1,297,173,000 distributed by the following classifications: nonresidential building \$512,939,000; residential \$470,348,000 and heavy engineering works \$313,886,000.

Percentage-wise, the gains during the first two months of this year compared with last were greatest in heavy engineering awards, which were up 54 percent. Nonresidential awards showed a 49 percent gain and residen-



Minnesota electrical contractors Ed Karst (left), Fergus Falls; and Glenn Ronning, Kenyon, hold a serious between-session conference at recent electrical convention in St. Paul.



New president of the Minnesota Electrical Association G. L. Haugland (left) of Appleton receives well wishes of retiring president Moreau Bailey, Albert Lea, at recent NCEI convention at St. Paul.

tial awards were up 1 percent.

More than a third of all contracts awarded during the first two months were for projects classified as publicly owned.

The gains in contracts awarded during the first two months were most pronounced in the reporting districts comprised of western Missouri, Kansas, Nebraska, Oklahoma; eastern Missouri, southern Illinois, western Tennessee and Arkansas; upstate New York; Minnesota, North and South Dakota; southern Michigan; the Middle Atlantic states; and western Pennsylvania and West Virginia.

Three areas showed decline in total volume during the two-month period compared with a year ago. These were: New England with a decline of 23 per cent; metropolitan New York and northern New Jersey, down 3 per cent; and southwestern Ohio and Kentucky, off 11 per cent.

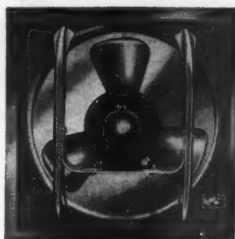
New England: Contrary to trends in most other areas, contracts awarded for construction in New England were trailing in dollar volume that reported for the first two months of last year by 23 per cent. Total for the first two months of this year was \$50,553,000. A 51 per cent decline was reported in residential building awards, a 16 per cent drop in nonresidential awards. Heavy engineering contracts were 46 per cent higher than in the first two months of last year.

Metropolitan New York and Northern New Jersey. The dollar volume of building contracts awarded in the first two months of this year was \$154,764,000, representing a 3 per cent decline from the total reported for the corresponding months of last year.

AIR EQUIPMENT TO HELP YOUR BUSINESS

JUST GIVE 'EM THE *Facts* —*They'll Want*

*BREEZO FANS



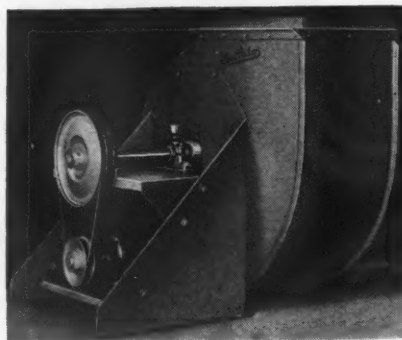
BUFFALO BREEZO FAN

standard, first grade motors. Six sizes, 8" to 24".

No superlatives needed here in making worthwhile sales! Just tell customers that these husky fans can easily be installed in walls where needed—that they move a lot of air at a trifling cost—that they're heavy-duty to keep running years and years with no attention but lubrication! Square, die-shaped steel panel; rigid, welded-on arms; heavy-gauge, die-stamped blades;

*BELTED VENT SETS

Here are high-efficiency centrifugal fans that give store, theatre, shop ventilation installations a high degree of flexibility. Models available for indoor or outdoor installation. Rotors are dynamically balanced for vibrationless operation.



BUFFALO BELTED VENT SET

RIGHT NOW is the time to get your facts on these quality-built "Buffalo" Fans—get lined up for the biggest ventilation year so far! Hundreds right in your territory waiting for you to TELL 'EM THE FACTS!

You'll Sell More Ventilation when you sell "Buffalo"—
Write for Data and Prices Now!

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Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Branch Offices in All Principal Cities



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- ★ HEATING
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- ★ AIR TEMPERING

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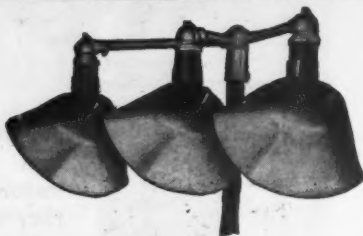
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- ★ PRESSURE BLOWING
- ★ CLEANING
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CUTTING COSTS IN EVERY BRANCH OF INDUSTRY

READY FOR INSTALLATION

IN SINGLE • DOUBLE OR TRIPLE UNIT COMBINATIONS

Exclusive
with
QUAD



MULTIPLE MOUNTED FLOODLIGHTS

"NO LITTER OF PARTS"

NO ADDITIONAL PARTS SUCH AS ELBOWS,
NIPPLES, AND OTHER PIPE FITTINGS RE-
QUIRED, AS THEY ARE ORDINARILY.

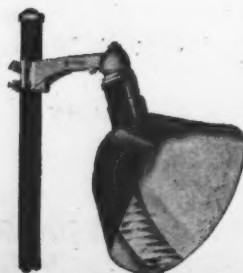
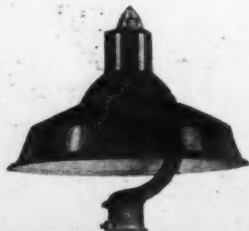
QUAD FLOODLIGHTS

The QUAD exclusive and practical mounting method saves planning and installing time, labor, and material. One type or size of reflector can be easily replaced with another without disturbing the wiring or detaching the bracket. Individual light control thru adjustable head means unusual flexibility and adaptability to all types of floodlighting needs. Simple focusing of the inner beam projector is a valuable feature. The beam projector snaps into the reflector neck and can be tipped forward or backward for exact focusing of lamp filament.

Get these 7 Advantages:

(1) unusual illuminating features enable them to meet all industrial and sports floodlighting requirements (2) furnished completely equipped for immediate mounting (3) adaptable for either pole top, pole clamp, or flat surface mounting (4) provide for either open or enclosed wiring (5) produce one, two, or three unit floodlight combinations (6) save time, labor, and material (7) low in cost and economical to maintain.

Write today for complete details!



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CHICAGO 7, ILL.



New president of the Rural Electrical Contractors Association R. E. Mattison (left), Oklahoma City receives congratulations of retiring president William Cagney, Jr., Evanston, Ill., at recent RECA convention in Chicago.

Nonresidential awards showed a gain of 8 per cent, heavy engineering awards were up 3 per cent; and residential contract volume was reported down 10 per cent.

Upstate New York: Total awards in the first two months of this year were reported at \$65,420,000, a gain of 94 per cent over the corresponding period of last year. A fourfold gain in heavy engineering awards was reported, with a 48 per cent increase in nonresidential building, and a 42 per cent gain in residential contract volume.

Middle Atlantic States: Building and construction contract volume in the first two months amounted to \$162,424,000, showing a gain of 36 per cent over the corresponding period of last year. Heavy engineering awards led the advance with a gain of 192 per cent. Nonresidential volume was up 24 per cent, and residential awards gained 13 per cent.

Southeastern States: The 19 per cent gain in all awards during the first two months of this year compared with the corresponding period of last brought the total of all contracts to \$145,400,000. A 37 per cent gain in nonresidential awards, and a 38 per cent gain in residential contract volume offset a 24 per cent decline in heavy engineering works.

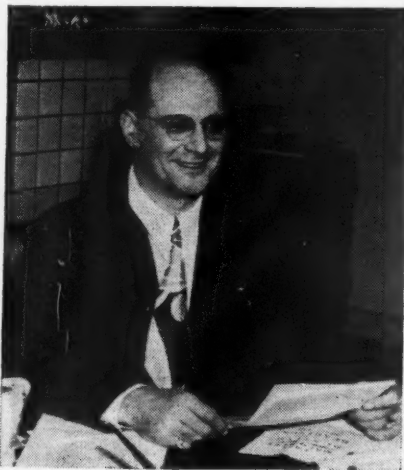
Western Pennsylvania and West Virginia: The total of building awards in the first two months of this year was \$65,676,000, revealing a 41 per cent gain over the corresponding period of last year. Nonresidential dollar volume was up threefold in the first two months, while heavy engineering awards gained 133 per cent. Residential contracts showed a sharp 52 per cent drop.

Northern and Eastern Ohio: A total of \$50,794,000 in contracts awarded was reported for the first two months of this year. This total represented an 18 per cent increase over the corresponding period of last year, with nonresidential contracts up 61 per cent, residential down 15 per cent, and heavy engineering awards off 9 per cent.

Southwestern Ohio and Kentucky: The total volume of building awards in the first two months of this year was \$33,125,000 to indicate an 11 per cent decline from the total for the corresponding period of last year. Compared with last year's first two months, nonresidential awards were off 14 per cent, residential awards were off 25 per cent, and heavy engineering contracts were up 34 per cent.

Southern Michigan: Marked by phenomenal gains in nonresidential contracts awarded, the volume of all awards was up 63 per cent during the first two months of this year compared with the corresponding period of last year. The total of all awards in the first two months was \$63,264,000. Nonresidential awards were up 173 per cent, residential awards were up 30 per cent, and heavy engineering awards were reported down 11 per cent.

Northern Illinois, Indiana, Iowa, Wisconsin, Northern Michigan: A 48 per cent gain in contracts awarded during the first two months of this year compared with the corresponding period of last year was reported. The total of all contracts reported was \$143,367,000 during January and February combined. Nonresidential volume doubled, residential awards were



Active in organizing a NISA chapter in District 7 (Columbus, Ohio area) is Harry Kollus, owner of Reliable Electric and Equipment Co., Zanesville, Ohio. Harry's motto is to do everything well, even relaxing. An accomplished bowler, he travels extensively entering tournaments and carrying home trophies.

POWER CIRCUIT TRANSFORMERS



THE most economical way of providing low voltage circuits for the lighting and operating of machine tools is to run a branch line from the power line, using a transformer to step down the voltage.

Dongan Transformers are being used for this purpose in industrial plants throughout the nation, reducing installation time and also conserving critical materials.

DONGAN ELECTRIC MFG. CO.

2980 Franklin

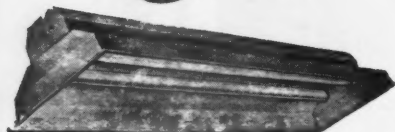
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Since Nineteen-Nine*

DONGAN TRANSFORMERS

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INDUSTRIAL LIGHTING EQUIPMENT



• Two-fold advantage . . .
Good Looks and Good Lighting

The trend is toward not only good lighting, but good-looking lighting installations . . . MULTI will help you get most of those profitable jobs because this is the line for every need. MULTI Units meet present day demands for indoor and outdoor lighting—for general or localized lighting and in fluorescent or incandescent types. Modernization demands these units and they pay a fair profit on every installation where they are used.

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MULTI ELECTRICAL MANUFACTURING CO.

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A FULLY automatic Thermal Relay (fluorescent starter) scientifically made to assure maximum economy of operation, greater reliability and more consistent performance.

A thermostatic switch equipped with silver contacts, carbon resistor and nichrome heater coil, bonded in a ceramic insulating material of high dielectric strength. Industrial Electronics Corporation products are successfully serving industrial and commercial plants, municipalities, office buildings, stores, railroad terminals, shipyards, schoolrooms . . . wherever dependable lighting is demanded.

The (SP-15-20) for use with either 15 or 20 watt lamps
The (SP-30-40) for use with either 30 or 40 watt lamps
The (SP-100) for use with 100 watt lamps

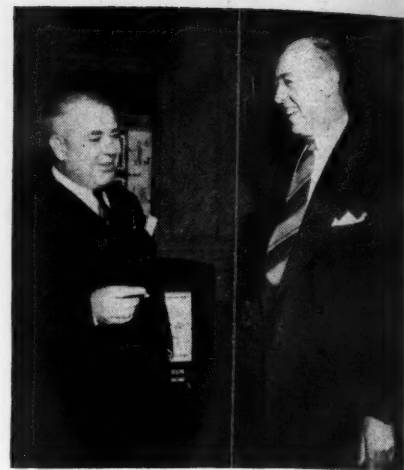
Ask for descriptive literature

INDUSTRIAL ELECTRONICS CORP.

80 Bank Street



Newark, N. J.



Contractor H. M. Carmichael, Davenport, Iowa chats with J. J. Dore (right), manager, Nebraska-Iowa Electrical Council, Omaha, at recent Chicago NAWB Conference.

up 9 per cent, and heavy engineering awards showed a 22 per cent gain.

Eastern Missouri, Southern Illinois, Western Tennessee, Arkansas: The total of awards in the first two months of this year was \$69,123,000, reflecting a 94 per cent gain over the corresponding period of last year. Nonresidential awards were up threefold, residential awards were up 43 per cent, and heavy engineering awards showed a 24 per cent gain.

Louisiana and Mississippi: Contracts awarded during the first two months showed a modest 9 per cent increase over the corresponding period of last year. The total awards in January and February was \$44,352,000. Nonresidential awards were reported up 127 per cent, while residential awards were off 10 per cent, and heavy engineering contracts were down 12 per cent.

Western Missouri, Kansas, Nebraska, Oklahoma: The total of awards in January and February combined was reported as \$94,130,000 indicating a phenomenal 172 per cent gain over the total shown for the first two months of last year. Nonresidential awards were up 285 per cent, residential awards were up 56 per cent, and heavy engineering contracts were up 208 per cent.

Minnesota, North Dakota and South Dakota: The dollar volume of contracts awarded in the first two months of the year was reported as \$30,660,000 to show a 63 per cent gain over the corresponding months of last year. Nonresidential awards increased 102 per cent, residential awards fell off 30 per cent, and heavy engineering awards showed a gain of 164 per cent.

Texas: During January and February contracts amounting to \$124,121,000 were awarded in Texas to show a 3 per cent over the correspond-

ing-months of last year. Nonresidential awards declined 21 per cent, residential awards increased 6 per cent, and heavy engineering awards showed a 56 per cent gain.

Maher Heads Chicago Motor Shop Group

P. J. Maher, Excel Electric Service Co., was elected president of the Electric Motor and Service Association (Central District Chapter, NISA). Others serving with him on the 1948 official staff are: Vice president—H. P. Lehman, Lehman Electric Co.; secretary—J. G. Lessel, Central Motor and Repair. Continuing as treasurer and executive secretary respectively are: A. J. Jeffries, Bowers & Clark; and Herbert Binner.

Members of the board of directors are: Thomas Agosto, Baird Rogers (Rockford), Joseph Borovec, Burton R. Hohman, Paul M. Sievert, and Arthur Wagner, Sr.

New Electrical Firm in Bradenton

W. S. Stewart has announced the opening of a new business in Bradenton, Florida, to be known as the Stewart Electric Company, located at 626 Thirteenth St. W.

Mr. Stewart, former electrical and building inspector for the city of Bradenton, will engage in electrical construction and maintenance work.



A. R. Mackey, shop superintendent, Lima Armature Works, Inc., Lima, Ohio, is a staunch believer in shop safety; helped design a bake oven heated by heat exchanger in adjacent boiler room. Scheme keeps gas flames away from dipping and baking operations.

FULLMAN

Latrobe

PRODUCTS

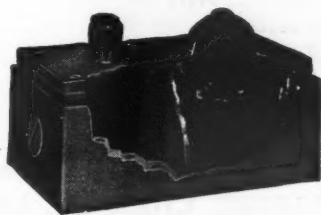
★ FLOOR BOXES ★

WIRING SPECIALTIES

QUALITY ALWAYS PAYS

The materials used in the manufacture of "Latrobe" Floor Boxes and Wiring Specialties are of the highest quality obtainable.

That is why "Latrobe" Products never falter nor fail after installation; but render absolutely top grade performance year in and year out.



No. 252-R Floor Box

This dependable Two Gang Adjustable Box has No. 208 Receptacle in one section. One cover has 1/2" Flush Brass Plug; the other 2" Flush Brass Plug.



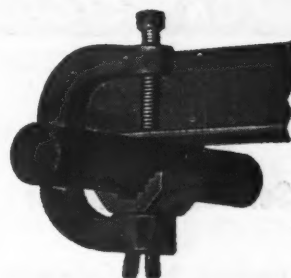
No. 110 "Latrobe" Watertight Box

Using 3 1/2" diameter Cover Plate and No. 208 Receptacle, this No. 110 Box is so simple and easy to install that it saves 15 to 20 minutes installation time per box. Is safe and dependable with plenty of wire space inside box.



No. 284 Nozzle with No. 200 Cover Plate

Here is the neatest, most compact-fitting Duplex Receptacle Nozzle on the market. Is furnished with 1/2" or 3/4" Brass Pipe Extension.



No. 470 "Latrobe" Pipe or Conduit Hanger

Made of highest grade malleable iron, this sturdy hanger is quickly and easily installed and hangs pipe or conduit 1/2", 3/4" and 1" to steel beams 3/4" thick.



Keystone Fish Wire

Finest grade flat steel wire, expertly tempered. Comes in ten sizes to suit the lightest work up to the heaviest power wiring.

Sold Only Through Wholesalers



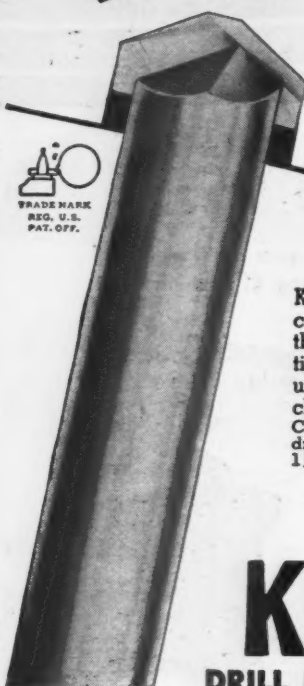
"Bull Dog" BX Cable Staples

Excellent quality staples that never slip or shake loose. Packed in cartons, kegs and barrels.

FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA

EASY!

BECAUSE THE
CUTTING EDGE
is
KENNAMETAL



Kennadrills have cutting tips of Kennametal cemented carbide—the metal that is far harder and more durable than tool steel. No starting punch needed—Kennametal tip takes hold readily, drills fast, retains sharp edge under heat and abrasion of cutting. Design assures clean, accurate drilling in all types of masonry. Can be used in any rotary electric drill. Available in sizes for drilling holes: $\frac{1}{8}$ ", $\frac{3}{16}$ ", $\frac{1}{4}$ ", $\frac{5}{16}$ ", $\frac{3}{8}$ ", $\frac{7}{16}$ ", $\frac{1}{2}$ ", $\frac{9}{16}$ ", $\frac{5}{8}$ ", $\frac{3}{4}$ ", $\frac{7}{8}$ ", 1 ", $1\frac{1}{8}$ ", $1\frac{1}{4}$ ", and $1\frac{1}{2}$ ".

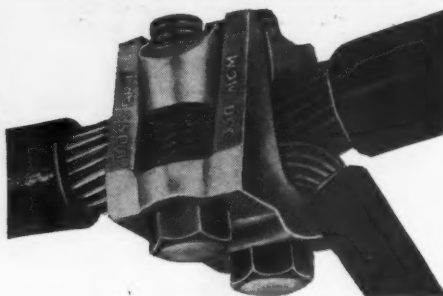
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KENNAMETAL Inc., LATROBE, PA.

KENNADRILLS

DRILL MASONRY FASTER, CHEAPER, EASIER

DOSSERT CONNECTORS

DOSULON
Bolt Type
Service Connector



A rugged, high strength, bolt type Service Connector for conductor sizes from 2/0 to 1000 MCM. Each size Connector is designed to accommodate two maximum size conductors and accommodate all combinations of conductors down to the combination of the maximum size conductor and one No. 8 solid. Body of Connector is made of a high strength, high copper bronze, and is equipped with high strength Everdur bolts. The compact design of this connector facilitates a neat taping job.

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"Insist on a Genuine DOSSERT"

To be sure of a genuine DOSSERT make sure the name DOSSERT is on your connector.

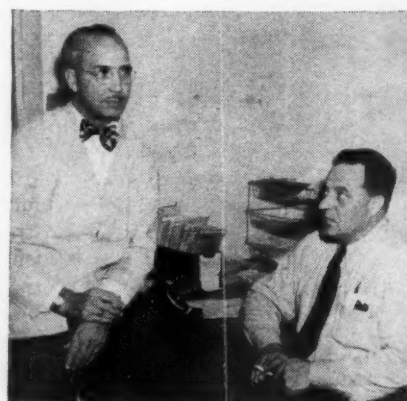


Checking over electrical plans of the new plant of the Kingston-Conley Electric Co., Division of Hoover Company at Cambridge, Ohio are (L to R) Paul Jones, project superintendent of the Gustav Hirsch Organization, Inc., Columbus electrical contractors and L. Hird, Hoover Company resident engineer.

Book Reviews

Selling Appliances

A comprehensive manual for electric power and appliance selling and promotion, titled "The Electrical Appliance Sales Handbook", is designed for the use of electrical salesmen representing manufacturers, distributors, dealers, utilities, cooperatives and municipal plants. As an aid to sales executives in developing merchandising and promotional programs, considerable data are included pertaining to the rural and small town markets, performance, operating costs and major sales features of many leading electrical appliances. The book is written by



Residential wiring specialists C. J. Rice (left), owner, Westgate Electric Co., Columbus, Ohio and C. A. Birle, who handles local house wiring projects, discuss the present market. Westgate's activities include rural and farm wiring throughout the nation.



Pondering a perplexing communication system problem are Russell Johnson (left) telephone engineer and Col. Gustav Hirsch, president Gustav Hirsch Organization, Inc., one of the leading electrical engineering and contracting organizations in Columbus, Ohio.

Laurence Wray, managing editor of *Electrical Merchandising* who has been connected with this field for two decades and has devoted the past 18 months to compiling the material for the book.

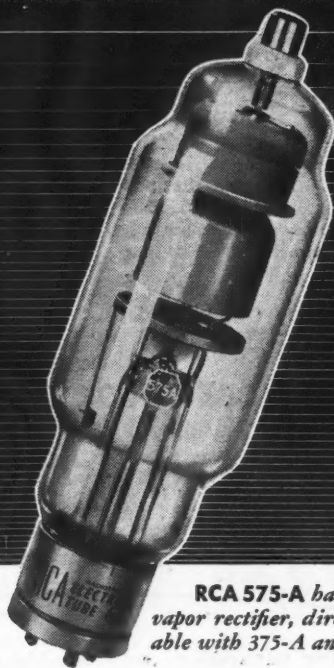
Engineering Aid

"Natural Trigonometric Functions" should be a great time saver to engineers. Every ten seconds of arc are listed to seven decimal places. Compiled by Howard C. Ives, Civil and Consulting Engineer, the book is divided into two parts; the first part including tangents, cotangents, sines and cosines; the second part including lengths of arcs, radii for arc and chord definition, functions of curves, corrections for tangent distances, definitions, theory and explanation of the tables. Size $6\frac{1}{2}$ by $9\frac{1}{4}$, the book has 351 pages. Priced at \$9.00, it is published by John Wiley and Sons, Inc., 440 4th Avenue, New York 16, N. Y.

Electric Distribution

For anyone connected with or interested in the planning, design, construction, operation, maintenance, inspection or supervision of electric distribution systems, a book called "Electric-Distribution Fundamentals" contains the essential data, facts, tables and diagrams for a comprehensive understanding. Written by Frank Sanford, distribution engineer of the Cincinnati Gas and Electric Company, the book explains the basic laws by which a distribution system works, how the system is planned, designed and constructed and how service and operat-

RCA TUBES FOR INDUSTRY



RCA 575-A half-wave mercury-vapor rectifier, directly interchangeable with 375-A and UE-975A.

... long service life in continuous-duty applications

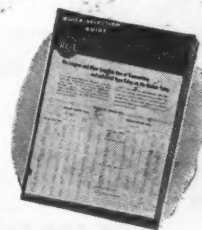
■ You can count on the quality and ruggedness of RCA industrial electron tubes to hold service failures to a minimum. The more than 260 types in the line are directly interchangeable with other standard types.

For your convenience, RCA industrial electron tubes are now available directly from RCA or from your local RCA Tube Distributor.

The Fountainhead of Modern Tube Development is RCA

Get this Helpful Guide

Bulletin 2F403 contains the data you need for the quick selection of the RCA industrial electron tube types to meet your renewal requirements. Get a copy; write RCA, Commercial Engineering, Section ET77, Harrison, N. J.



TUBE DEPARTMENT

RADIO CORPORATION OF AMERICA
HARRISON, N. J.

It Sells on Sight!
THE NEW
HEINEMANN
SAFELET
CIRCUIT BREAKER

An outlet with a pilot light that shows when circuit is in use

When you're talking to a customer, explain that this equipment, which may be conveniently installed where electrical appliances are used, means A SAFE OUTLET AT ALL TIMES. Plug in an electric iron, a drill or any other apparatus—the light warns you that the current is "ON." If a short or overload occurs the circuit breaker immediately shuts off the current for the particular appliance that you are using WITHOUT affecting the main fuse or breaker. When the condition is corrected, just flip the handle—the current is restored.

**CUTS OUT ON DANGEROUS OVERLOADS
 OPENS AT ONCE ON SHORT CIRCUIT**

ASK YOUR JOBBER FOR SAFELETS

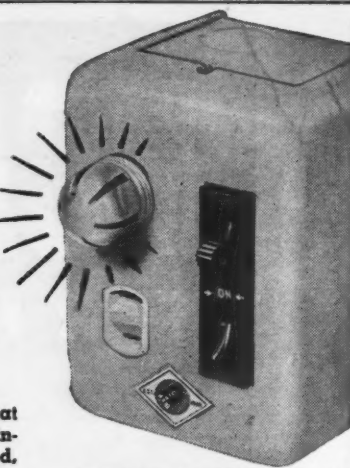
Write for Further Information



HEINEMANN ELECTRIC COMPANY

132 Plum St.

Trenton, N. J.



MAKE EXTRA PROFIT by the sale of the **HEINEMANN SAFELET**. The breaker is entirely magnetic, instantaneous on "shorts", but time-delay unit permits passage of inrush current or harmless overload. **NO HEAT GENERATED.** Listed by Underwriters Laboratories.

RATINGS

115 Volts—6, 10, 15 amps.

230 Volts—6, 10 amps.

ing routines and details are handled. Methods and equipment are discussed in detail. Some of the main chapters deal with the selections, design and application of transformers; design of carrying lines; problems of maintenance and the economic considerations entering into intelligent selection of types of systems and equipment. Details discussed are voltage drop, wire size calculations, transformer connections, power factor improvement and inductive reactance. Published by the McGraw-Hill Book Company for \$3.50, the book contains 252 pages and measures 6 by 9 inches.

Encyclopedia of Safety Aids

The 1948 edition of Best's "Safety Directory" covers the entire field of safety, fire protection and control, hygiene, first aid and sanitation and combines many of the practical features of a safety manual, directory, index, catalog and encyclopedia. With illustrations and text the book shows what safety products or devices to use for specific hazards, how to use them and where to get them. The manual is of particular value to safety directors and engineers, production men and inspectors, purchasing agents and medical officials.

A feature of the book is the indexing and subject-grouping system, which makes it easy to locate various products even when the type or name of the equipment is unknown to the book used. Logical arrangement of subjects furnishes a check-list of hazards. Typical sections are arm and hand, body and leg, eye and face, fire, and so on. Brief discussions of the purpose, construction and application of pro-

For unexcelled dependability and permanence

Specify and Install

TIME SWITCHES

EQUIPPED WITH SYNCHRONOUS,
 SELF-STARTING MOTORS

A. C. OR D. C. OPEN OR CAN TYPE
 WITH TUBE-BASE PLUG-IN FEATURES



Highest quality material and unexcelled craftsmanship combine to make Automatic Time Switches the preference of those who demand long life dependability backed by an unconditional guarantee.

Compact, carefully engineered Automatic Time Switches have new type, easily set trip levers. Trip levers and dial are visible thru window in attractively finished, tamper-proof case.

Stock Models: Single Circuit, Single Pole, 10 Amperes Capacity to Two Circuit, Four Pole, 45 Amperes Per Pole Capacity. Special models engineered to your requirements.

RELAYS

Automatic Electric Relays . . . Midget, Interlocking, Circuit Control, Latching, Adjustable . . . are built to exacting high standards to assure unexcelled dependability. Custom built relays designed to your specifications.

Accurately rated Automatic Electric Relays deliver "Diamond Quality" performance.

Write for complete specifications.

LOOK FOR THE DIAMOND SEAL FOR DIAMOND QUALITY



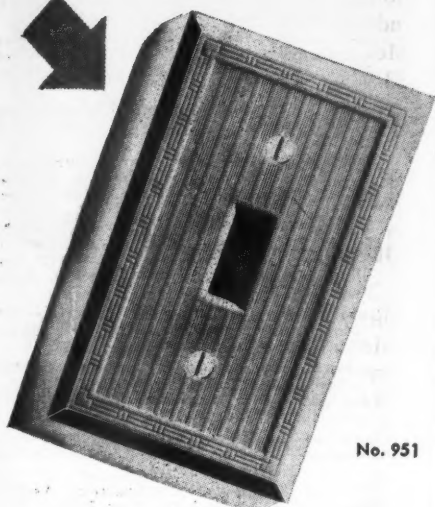
Automatic Electric MFG. CO.

50 STATE STREET
 MANKATO, MINNESOTA



Electrical engineer C. L. Parker handles the interior wiring and electrical construction activities of the Gustav Hirsch Organization, electrical engineering and contracting firm of Columbus, Ohio.

Note the design



No. 951

Extra heavy Bakelite FLUSH PLATES FOR TOP QUALITY JOBS

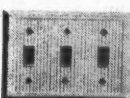
Pressed heavy Bakelite in this widely popular design combines beauty with rugged strength.



No. 953



No. 957



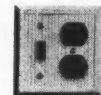
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No. 963



No. 965



No. 959



No. 967



No. 955

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Singles:	Brown \$10;	Ivory \$12
Doubles:	Brown \$20;	Ivory \$24
Triples:	Brown \$30;	Ivory \$36

Each plate packaged in an individual envelope complete with METAL screws.

ORDERS SHIPPED IMMEDIATELY . . . WRITE FOR SAMPLES AND DETAILED INFORMATION

(Prices on lower priced line of flush plates sent upon request)



A-P ELECTRICAL
DEVICES CORP.

501 N. Figueroa St. • TR 0851 • Los Angeles 12
Mail address: P.O. Box 2135, Terminal Annex,
Los Angeles 54



Unusual jobs are daily fare of Owen Shaw, shop foreman of Reliable Electric and Equipment Co., Zanesville, Ohio motor repair organization. Here he winds a 2-pole, one horsepower motor for a lens grinding machine.

protective clothing; head, eye and foot coverings; fire fighting and welding equipment; non slip floor coverings and stair treads; scaffolding; dust exhausts; safety practices; machine guards and related aids are included. Items are cross-indexed by product, purpose and manufacturer. Manufacturers are listed under each type of equipment and also alphabetically by states and cities. With experience gained through the publication of the first edition, editorial content has been increased, rewritten in many cases for brevity or clarity and compiled as an all-round helpful source of safety information. Sized 8 by 11 inches, the book is 494 pages in length. Priced at \$5.00, it is published by Alfred M. Best Co., 75 Fulton Street, New York 7, N. Y.

Dates Ahead

Edison Electric Institute—14th Annual Sales Conference, Edgewater Beach Hotel, Chicago, Ill., April 6-8.

Electrical Manufacturers Representative Association, Inc.—Annual Electrical Show, Alcazar, Baltimore, Md., April 6-8.

Midwest Power Conference—Tenth annual conference, sponsored by Illinois Institute of Technology, Sheraton Hotel, Chicago, Ill., April 7-9.

San Francisco Real Estate Board and Associated Home Builders of San Francisco, Inc.—Home Show, Civic Auditorium, San Francisco, Calif., April 7-14.

International Association of Electrical Inspectors—North Carolina Chapter, Carolina Hotel, Raleigh, N. C., April 13-14.

International Association of Electrical Inspectors—Georgia Chapter, Hotel Dempsey, Macon, Ga., April 15-16.

Home Builders Council of New York, New Jersey and Connecticut—Annual Home Show, Grand Central Palace, New York, N. Y., April 17-24.

Illuminating Engineering Society—Southwestern Regional Conference, Hotel White-Plaza, Dallas, Texas, April 18-20.

International Association of Electrical Inspectors—Florida Chapter, Hotel Floridian, Tampa, Fla., April 19-20.

National Industrial Service Association—Annual convention, Hotel William Penn, Pittsburgh, Pa., April 26-29.

Chamber of Commerce—Annual meeting, Washington, D. C., April 27-29.

You get ALL THREE with a BLACKHAWK PIPE BENDER



Blackhawk Benders do MORE than bend pipe. They include a Porto-Power Hydraulic Unit that performs this triple job:

1 PIPE BENDING
Bends rigid conduit and pipe of all popular diameters. Saves need for elbows, couplings and extra cutting and threading.

2 MAINTENANCE and PRODUCTION
Porto-Power pushes, pulls, bends, presses, spreads, and clamps—pulls gears, lifts machinery and licks scores of other jobs.

3 SPECIAL JACK
Compact Hydraulic Ram works in all directions— at any angle. A versatile, safe, remotely controlled jack.

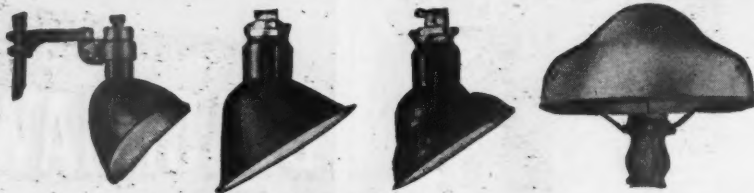
Blackhawk Mfg. Company,
Dept. P-2058 Milwaukee 1, Wis.
Mail Hydraulic Equipment catalog to:

Name

Company

Address

BLACKHAWK
WORLD'S LARGEST MANUFACTURER OF HYDRAULIC JACKS



Designed to Sell
OUTDOORS

FLOODLIGHTS
•
SIGN LIGHTS
•
EMBLEM LIGHTS
•
STATION
ISLAND LIGHTS

There are hundreds of applications where the A Bolite Reflectors shown above can be used to take full advantage of illumination out of doors. Business well recognizes the value of efficient lighting of signs, buildings, sales and parking areas to gain increased patronage. Extended night lighting of signs and billboards has proven profitable. And don't forget protective lighting is often a necessity.

Sold only through wholesalers

THE JONES
METAL PRODUCTS COMPANY
West Lafayette, Ohio



International Association of Electrical Inspectors—West Virginia Chapter, Parkersburg, W. Va., May 20-21.

Society of the Plastics Industry—Annual Meeting, Ambassador Hotel, Atlantic City, N. J., May 20-21.

Illuminating Engineering Society—Midwestern Regional Conference, Hotel Nicolet, Minneapolis, Minn., May 27-28.

Edison Electric Institute—Annual convention, Atlantic City, N. J., June 2-4.

Illuminating Engineering Society—Great Lakes Regional Conference, Hotel Statler, Detroit, Mich., June 16-8.

American Society for Testing Materials—Annual Meeting, Book-Cadillac Hotel, Detroit, June 21-25.

Cold Cathode Fluorescent Lighting Exhibit—Grand Central Palace, New York City, July 6-10.

American Institute of Electrical Engineers—Summer General Meeting, Palace of Fine Arts, Mexico City, Mexico, June 21-25.

Second International Store Modernization Show—Grand Central Palace, New York, N. Y., July 6-10.

International Association of Electrical Inspectors—Western Section, Denver, Colo., September 13-15; Northwestern Section, Salt Lake City, Utah, September 20-22; Southwestern Section, Oakland, Calif., September 27-29; Eastern Section, October 11-13; Southern Section, Heidelberg Hotel, Jackson, Miss., October 18-20.

Illuminating Engineering Society—National Technical Conference, Boston, Mass., September 20-24.

National Association of Housing Officials—Third annual exhibit of building and maintenance products, Olympic Hotel, Seattle, Wash., October 13-16.

National Electrical Manufacturers Association—Traymore Hotel, Atlantic City, N. J., November 8-13.

National Electrical Contractors Association—47th Annual Meeting, Roney Plaza Hotel, Miami, Fla., November 30-December 3.

Manufacturers News

D. M. SALSURY ELECTED PRESIDENT OF WESCO

Election of David M. Salsbury as president of the Westinghouse Electric Supply Company was announced recently.

Mr. Salsbury has been executive vice president of Wesco, a wholly-owned subsidiary of the Westinghouse Electric Corporation, since 1946, and vice president since 1944. He succeeds B. W. Clark, who has held the dual posts of president of Wesco and vice president in charge of sales of the parent company. Mr. Clark will continue to have responsibility for all sales activities of the Westinghouse Electric Corporation.

Mr. Salsbury started his career with the Northern Electric Company, Calgary, Canada, in 1915. The following year he joined the Western Electric Company at Oakland, Calif., and went with the Valley Electric Supply Company in Fresno in 1917.

He became affiliated with the Electric Railway and Manufacturers' Supply Company of San Francisco in 1918, which was acquired by the Westinghouse Electric Supply Company two years later. In 1933 Mr. Salsbury became manager of the Supply Company's Salt Lake City branch, when Westinghouse took over the Inter-

CHELSEA FANS & BLOWERS



BB—ALL PURPOSE
12" to 30"
1200 to 7000 CFM



OPJ—OCTOPUS JR.
3-4" Hoses
CFM Per Hose
10" = 412 50" = 297



PH—PENTHOUSE
24" to 48"
5700 to 21500 CFM

—for every
ventilating
requirement in



**Factories, Shops, Offices,
Schools, Institutions, etc.**

CHELSEA fans, blowers and exhausters move large volumes of air quickly, quietly and efficiently—your guarantee of peak efficiency from workers, key personnel and staff. The complete CHELSEA line includes everything from heavy industrial types, to pedestal fans for spot air circulation. Keep everyone alert, keen,—“on their toes”. Install CHELSEA ventilating equipment—NOW!

Literature describing the CHELSEA line will be sent promptly on request without obligation.

Address Inquiries to Dept. EC.

INSIST ON CERTIFIED RATINGS! Air delivery ratings of all CHELSEA products are determined by the test method prescribed by the PROPELLER FAN MANUFACTURERS ASSOCIATION and the American Society of Heating and Ventilating Engineers.





CP—BLOWER
3 Sizes
650 to 1020 CFM



IND—INDUSTRIAL
24" to 60"
5700 to 32000 CFM



DXB—BOOSTER
16" to 36"
2000 to 9500 CFM

CHELSEA FAN & BLOWER CO., INC.

1200 GROVE STREET, IRVINGTON 11, NEW JERSEY



PIERCE

Amazing

SCIENTIFICALLY DESIGNED

FUSE LINK

Keeps

EQUIPMENT OPERATING

during safe loads

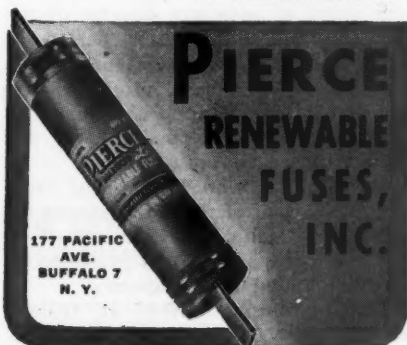
(100% to 200%)

Blow points are accurately computed. Extra surface area carries away heat. Ruggedly built tubular bridge and screen ventilated case contributes to its efficiency and lasting good value.

Only
**PIERCE
HAS**

- 1 BALANCED LAG LINK
- 2 SCREENED VENTILATION
- 3 TUBULAR BRIDGE

FREE: Balanced Lag Link to inspect and test. Specify amperage, voltage.



177 PACIFIC
AVE.
BUFFALO 7
N. Y.

**PIERCE
RENEWABLE
FUSES,
INC.**



D. M. SALSURY

Mountain Electric Company. He was named North Pacific District manager with offices in Seattle, Washington, in 1939 and four years later was transferred to the New York office as general manager of the company.

M. P. Nickerson was named vice president. He will continue his present duties as general A & S manager at headquarters, New York City. He worked for various electrical contractors and jobbers in Boston until 1925 when he became stores manager of WESCO, Boston. In September 1929 he was made assistant sales manager, Cleveland and three years later joined the Eastern district, New York City as assistant district sales manager. In October 1936 he came to Wesco headquarters, as syndicate representative and in November, 1943 was named general A & S sales manager of the Wesco organization.

L. W. Fernandes has been named North Pacific district lamp manager, Seattle. Prior to this appointment he was North Pacific District sales promotion manager.

J. Edward Sheasgreen has been named New England district specialties sales manager. Prior to his appointment, he was an appliance salesman at Wesco, Bangor.

Elbert Kramer has been appointed Wesco, Los Angeles Appliance sales promotion manager.

Howard Farley has been named Southwestern district A & S Sales Promotion manager.

M. J. Kaiser was recently appointed Northern district farm sales manager with headquarters in Milwaukee. He was formerly an A & S salesman, Milwaukee.

ALLIS-CHALMERS APPOINTMENTS

James M. Barker of Chicago, chairman of the boards of the Allstate Insurance Co. and the Allstate Fire Insurance Co., has been elected to the board of directors of Allis-Chalmers Manufacturing Co. Mr. Barker replaces Alfred J. Kieckhefer, president of the National Enamel & Stamping Co. of Milwaukee, who has resigned.

Announcement has been made of the

IT'S POWERFUL

IT'S SELF-CONTAINED



**ONE
MAN
GANG
OF
ALL
WORK**

the

SYNTRON

Gasoline Hammer

PAVING BREAKER

A really **SELF-CONTAINED** tool—requiring no air compressor or battery for operation—that will save you **MONEY AND TIME.**

Busting concrete

Cutting asphalt

Digging shale, clay

Tamping backfill

and a host of other jobs.

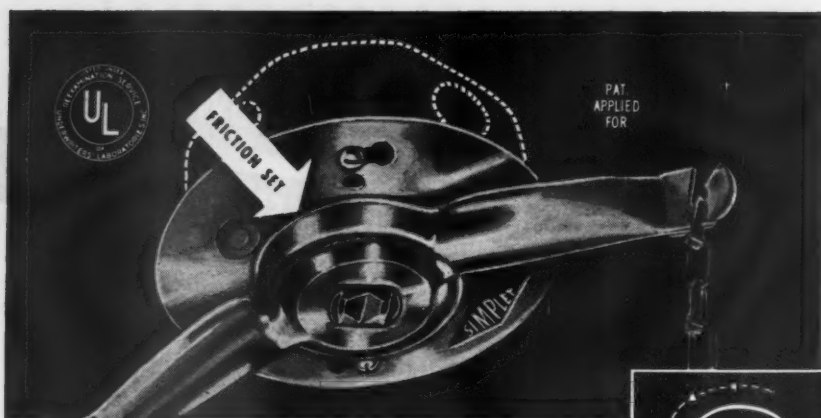
Write for Bulletin 8-45

SYNTRON CO.

690 LEXINGTON

HOMER CITY, PA.

**EASIER - FASTER
CHEAPER**



NEW "Friction-Set" FIXTURE HANGER . . .

That Adjust With a Twist of the Wrist!

At last you can get a Fixture Hanger that turns to any angle after being screwed to an outlet box. Although base and receptacle remain stationary, hanger arms may be turned to align with any preconceived lighting plan. Exclusive Friction Ring firmly holds fixture in selected position. Hanger screws on to 3 1/4" or 4" outlet boxes, no other fastening necessary. Furnished complete with receptacle, two 5' chains, hooks and cord clips.

Friction-Set K100 . . . List Price \$1.10

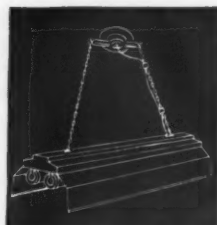
Also Available with 3 Wire Solid Ground Receptacle
Write for Bulletins K25 and K26

SIMPLET ELECTRIC COMPANY

3600 West Potomac Avenue • Chicago 51, Ill.
112 Charlton Street • New York 14, N. Y.



360° Adjustment



For any fixture position

appointment of W. A. Roberts and W. C. Johnson, executive vice presidents, to the executive committee of the board. They replace Mr. Kieckhefer and the late Herman W. Falk.

John R. Queen, for the last two years Texrope sales representative in the New York district office, has been named dealer supervisor at New York for the company's Empire region. Territory embraced by the Empire region is covered by district offices in New York, Buffalo, Newark, Rochester and Syracuse.

Larison H. Taylor, formerly vice president of the General Electric Credit Corporation, has been appointed assistant to the manager of marketing of the General Electric Company's Appliance & Merchandise Department, Bridgeport, Conn.

Harold H. Mount, who previously held that position, has been transferred to Dallas, Texas, as assistant manager of appliance sales in the southwestern district.

GRAYBAR ELECTRIC MANAGEMENT CHANGES

Several changes voted at the recent annual meeting of the Voting Trustees and Board of Directors of Graybar Electric Company, Inc., New York, have been announced by A. H. Nicoll, president. C. J. Cossmann, director and district manager at Chicago, was made a voting trustee. A. C. Lamperti, secretary and comptroller and director, was made a member of the executive committee. R. B. Wilkinson, treasurer, was made a director.

WESTINGHOUSE APPOINTMENTS

The appointment of two sales executives for the central district office of the Westinghouse Electric Corporation in Pittsburgh has been announced. Charles H. Weaver has been named industrial manager and Quincy M. Crater becomes transportation manager, each responsible for central district sales activities in his respective field.

Dr. John A. Hutcheson has been appointed director of the Westinghouse Research Laboratories, succeeding Dr. L. Warrington Chubb. Dr. Hutcheson assumes his new post after four years as associate director of the Laboratories. During this period he directed the company's extensive wartime radar research program and later the formulation of plans for atomic energy development. He will remain active in both fields.

Dr. Chubb, who is retiring from active direction of the Laboratories for reasons of health, has been named director emeritus and will continue to serve in an advisory capacity.

The appointment of L. H. Gillette as manager, Heating Section Sales, Transportation & Generator Division,

National insulating materials

A COMPLETE SERVICE

Research and field experience by the builders of NATIONAL Coils has resulted in the development of superior insulating materials.

Insulating materials that assure long life and trouble-free service when used in your electrical equipment, are available from NATIONAL.

NATIONAL is the complete source of all your insulation needs.

RAPID delivery from large stocks.
NATIONAL Insulation Engineers are near you—call one.

Varnished
Fabrics

Tapes

Sleevings

Tubings

Cords

Twines

Mica

Papers

Fibers

Varnishes

Cements

Compounds

Laminates

NATIONAL ELECTRIC COIL COMPANY

COLUMBUS 16,

OHIO, U. S. A.

ELECTRICAL ENGINEERS, MAKERS OF
ELECTRICAL COILS AND INSULATION



REDESIGNING AND REPAIRING OF
ROTATING ELECTRICAL MACHINERY

has been announced. His headquarters are in Meadville, Pa.

The Westinghouse Electric Corporation has announced the purchase of additional manufacturing facilities in Western Pennsylvania near Irwin, Pa., as part of a \$132,000,000 long-range, company-wide expansion and improvement program. The property was formerly owned by the General Foods Corporation and occupied by one of its divisions, the Jersey Cereal Company.

G-E CHANGES

The Lamp Department of the General Electric Company has purchased the former American Magnesium Corporation plant at 1099 Ivanhoe Road, Cleveland. The property, consisting of six acres of land, will become headquarters of the Lamp Department's Chemical Products Division, now located at Nela Park.

William Tennant has been appointed New York district representative for G-E conduit products. He was formerly connected with the company's wiring device and wire and cable sales sections in Bridgeport, Conn.

HOLTZER-CABOT APPOINTS ADVERTISING MANAGER

Alice Honore Drew, for the past five years advertising manager of Tel-Autograph Corporation, New York, has been appointed director of advertising, Holtzer-Cabot Motors, Boston. Miss Drew will make her headquarters at 101 Park Avenue, New York office.

One of the few women advertising executives in the industrial field, Miss Drew has been the recipient of numerous awards in recent years for outstanding performance in the planning and production of advertising and sales promotion campaigns.

AMERICAN STEEL & WIRE CO. APPOINTMENTS

O. B. Stuffer, Jr., has been named assistant manager, advertising, American Steel & Wire Co., Cleveland. Since 1944, he has been supervisor, advertising production.

John E. McGrath has been promoted to the position of assistant manager, market development, while C. C. Plumbach has been appointed director, merchandising market development.

NEW COMPANY TO MANUFACTURE INSULATING VARNISHES

A new company, the George C. Borthig Company, Inc. has started the manufacture and sale of electrical in-

PARTS

FOR

FANS MOTORS CONTROLS

PROMPT SHIPMENT FROM LARGE STOCK

AUTHORIZED PARTS DISTRIBUTOR

Brown-Brock-
meyer
Century
Cutler-Hammer
Delco
Diehl
Duro
Emerson

General Electric
Hamilton-Beach
Holtzer-Cabot
Howell
Hunter
Ilg
Leland
Marathon

Master
Peerless
Robbins & Myers
Star
Thor
Wagner
Westinghouse

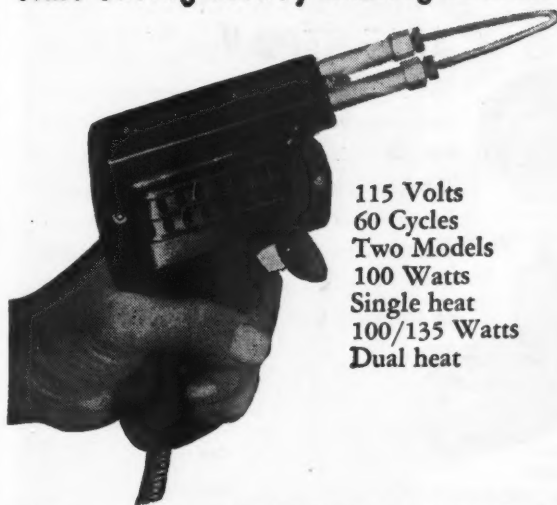
READING ELECTRIC COMPANY, INC.

Parts Distributors for the Manufacturer

200 William St. Beekman 3-7800 New York 8, N. Y.

WELLER SOLDERING GUN

Time Saving-Money Making Features



115 Volts
60 Cycles
Two Models
100 Watts
Single heat
100/135 Watts
Dual heat

See your radio parts distributor or electrical wholesaler. Or write direct for bulletin.

WELLER Mfg. Co.

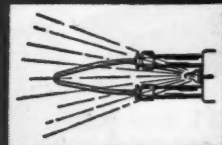
815 Packer St. • Easton, Pa.



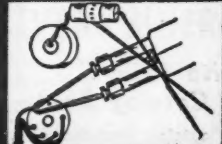
5 SECOND HEATING



ADJUSTABLE TIP



BUILT-IN SPOTLIGHT



LONG REACH



DUAL HEAT

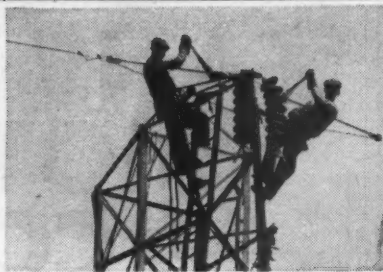
Want Safe, Easy Pulling?

There's a **COFFING** **SAFETY-PULL HOIST** (RATCHET LEVER TYPE) **FOR EVERY JOB**

You'll get more work done—faster and with greater safety—when you use a Coffing Safety-Pull Ratchet Lever Hoist for lifting, pulling or load binding. The Safety-Pull is simple in design and extremely easy to operate—yet durable and rugged in construction to handle heavy duty jobs day after day. Choose the hoist to meet your specific needs from the nine models available—with capacities from $\frac{3}{4}$ to 15 tons! You'll be ahead on time, on manpower . . . on safety.

SEND FOR BULLETIN WRL-5

OTHER COFFING PRODUCTS — Electric Hoists
• Differential Hoists • Hoist-Jacks • "Mighty-Midget" Puller • Spur-Geared Hoists • Load Binders • Trolleys.



Safety-Pull Hoists lift transformer to location with speed and safety

Why **COFFING** Is the **Better Hoist**

- Hooks of drop forged, heat treated steel.
- Dual ratchet and pawl assembly for maximum safety.
- Replaceable "Safety-load" handle will bend before any other part of the hoist gives.
- Handle is reversible—Hoist operates in any position.
- Every model factory tested to 100% over rated capacity.

THE COFFING HOIST COMPANY
DANVILLE, ILLINOIS

"EFFICIENCY" DEVICES FOR CONDUIT and CABLE SUSPENSION

Dependable against a 17,000 lb. direct pull

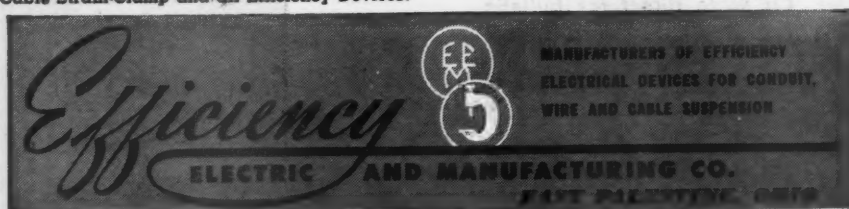
The "EFFICIENCY" CABLE STRAIN-CLAMP



The powerful grip of this clamp, by actual test, withstands a direct pull of over 17,000 lbs. A high ridge across the center and a U-bolt at each end of the cable channel keeps cable from slipping. Clamps are available in sizes from 1/10 to 1,500,000 CM. Furnished with clevis or eye, for AC or DC service as required.

Write today
for Catalog 38-A.

This catalog contains complete data on the Cable Strain-Clamp and all Efficiency Devices.



ulating varnishes at its plant in East Rutherford, N. J.

Officers of the new corporation, are George C. Borthig, president; David M. Kelly, vice president; and Edward E. Boyno, secretary. Previously all were associated with the John C. Dolph Company of Newark, N. J.

FAIRBANKS, MORSE ELECTS DIRECTORS

At a recent meeting of the Board of Directors of Fairbanks, Morse & Co., Chicago, two men from the ranks were elected directors of the company to replace A. E. Ashcraft and F. C. Dierks.

The two new directors are L. W. Stolte, who has been secretary of the company for the past year, and Frederick J. Heaslip, who has for a number of years been director of purchases.

J. H. HUMBLE NAMED SALES MANAGER OF KESTER SOLDER

Joseph H. Humble of the Kester Solder Company, Chicago, has been appointed general sales and advertising



J. H. HUMBLE

manager. Mr. Humble, who has been associated with Kester for 25 years, is considered one of the outstanding experts on solder in the country.

ALLEN-BRADLEY APPOINTMENTS

James M. White, formerly vice president in charge of manufacturing at Allis-Chalmers' Milwaukee plant, has joined the Allen-Bradley Company, Milwaukee. Mr. White is a member of the production management staff, in which capacity he will investigate cost and inventory methods and participate in handling production management problems.

L. C. Watson, formerly with Trumbull Manufacturing Company, has been

appointed sales manager of distributor sales of Allen-Bradley. Mr. Watson will make his headquarters in Milwaukee.

Allen-Bradley's Florida representative, Ward Engineering Co., Inc. of Jacksonville, has opened an additional office at 1217 W. Central Ave., Orlando, Fla.

ELECTRO MANUFACTURING CORPORATION APPOINTMENTS

The Bettis-Fickie Company has been appointed district manager for Western Missouri, Kansas, Oklahoma and Nebraska for the Electro Manufacturing Corporation of Chicago. Their headquarters will be in Kansas City, Mo.

The Charles E. Adams Company is the new Electro district manager in West Virginia, Western Pennsylvania and Eastern Ohio, with main offices located in Pittsburgh, Pa.

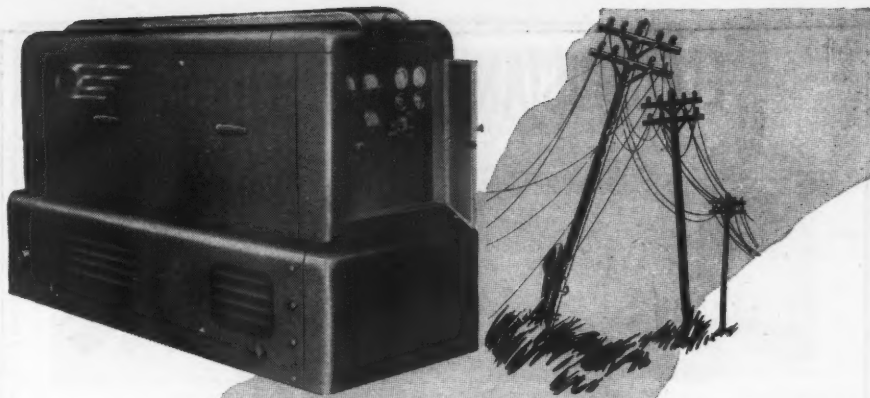
The Simpson Electric Company, Chicago, announces the appointment of Melvin O. Buehring as sales manager to succeed the late George H. Koch. Mr. Buehring, who handled factory expediting and priority work during the War, has been an assistant to Mr. Koch in the sales department since that time. Theodore Franks has been named to succeed Mr. Buehring.

Appointment of Sidney L. Chertok to the newly-created post of sales promotion manager of Solar Manufacturing Corporation, North Bergen, N. J. and its distributing subsidiary, Solar Capacitor Sales Corp., has been announced. In addition to his new responsibilities, Mr. Chertok will retain supervision over Solar's advertising and technical service departments.

Leo Schirtzinger has retired as Cincinnati district sales manager of Century Electric Company, St. Louis, Mo. P. F. Williams and W. C. Wetlaufer are now in charge of the Cincinnati district sales office.

Don Hamilton of New York, for several years a sales executive for the F. W. Fitch Co., has been appointed vice president in charge of sales of the Verd-A-Ray Corp. and of the Penetray Corp., Toledo, Ohio.

The H. O. Canfield Company, Bridgeport, Conn. has announced the appointment of Eliot W. Howard as sales manager in charge of both their industrial and trade division sales.



Guard Against Costly Power Failures with

ONAN STANDBY ELECTRIC PLANTS



When power fails, business comes to a standstill. Materials in process are wasted, men and machines stand idle, lives may be endangered. Prevent the disastrous effects of power failure with a low-cost, easy-to-install Onan Standby System. The generating plant starts automatically when commercial power fails, takes over the power load without interruption, stops automatically when power is restored. Many models: 350 to 35,000 watts, A.C.

D. W. ONAN & SONS INC.

2138 Royalston Ave. • Minneapolis 5, Minn.



ONAN STANDBY POWER

NO. B153

NO. B353

For MAXIMUM LIGHTING EFFICIENCY

STONCO

FLOODLIGHTS
WEATHERPROOF
CAST ALUMINUM

NO. B153—3 light assembly shown mounted on island light uses PAR 38 lamps.

NO. B 353—3 light assembly uses 300 or 500 watt sealed beam weather-proof floodlamps

PREFERRED EVERYWHERE

For Service Stations, Sports Areas, Industrial, Advertising, etc.

FEATURING the SEALED Beam Type Lamps (Beam and Light Combined in One Unit—No Reflectors) Simplicity—Economy—Adaptability

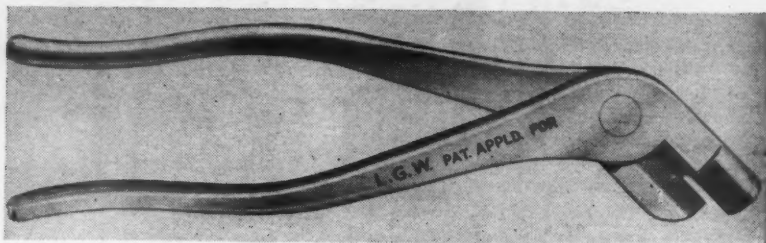
Sold Exclusively Through Wholesalers—Prompt Deliveries—Write for Catalog.

Stone

MANUFACTURING CO.

489 Henry Street
Elizabeth 4, N. J.

ELECTRICIAN'S REAL FRIEND



L. G. W. ANGLE-LOCKNUT PLIERS

Will tighten locknuts and bushings in outlet boxes.

Will cut wire, will skin the ends of rubber covered wire.

Will remove the burrs from the inside or outside ends of conduit or steel tube.

Electrical contractors are proud of their conduit and steel tube electrical installations.

They want their jobs securely and permanently grounded from the panel to the last outlet on the circuit.

That is the reason so many electricians have bought L.G.W. Angle-Locknut Pliers.

The screwdriver and hammer method of tightening locknuts and bushings is now history.

MADE TO LAST FOREVER

Your Supplier Will Fill Your Order.

White Manufacturing Co.

3802 Poe St.

Dallas 4, Texas

Suggest a Time Switch...

SPECIFY RELIANCE

• Every installation that calls for automatic control calls for a Reliance Time Switch. Completely automatic . . . easy to install . . . proved through 35 years of dependable service . . . Reliance Time Switches provide added volume for contractors and better service for users. You can rely on the Reliance line. Ask your distributor or write Reliance Automatic Lighting Co., 1937 Mead Street, Racine, Wisconsin.



RELIANCE AUTOMATIC LIGHTING CO.

1937 Mead St. Racine, Wis.



"Badger" Heavy Duty Automatic Switches.



"Model-W" synchronous Automatic Switches

EQUIPMENT NEWS

[FROM PAGE 110]

live parts when open. After cutout has operated, the indicating arm projects from the bottom of the door, clearly showing that the fuse has blown. General Electric Co., Schenectady 5, N. Y.

Electric Heaters

Series 230 built-in wall fan-glo heaters are thermostatically controlled. The thermostat automatically turns the heater on and off at the temperature specified. It has a range of from 56° to 84° F, and is equipped with a thermometer. The metal case of thermostat is finished in ivory enamel; it has a 25 amp. rating, 115 volts or 15 amp., 230 volts a-c. It carries Underwriters' approval. It produces infrared rays plus fanforced heated air. Markel Electric Products, Inc. and LaSalle Lighting Products, Inc., Buffalo, N. Y.

New Equipment Briefs

A new solderless and tapeless wire connector has been announced by Holub Industries, Inc., Sycamore, Ill. It joins 108 wire combinations. . . . "Alumispun" circline fluorescent fixtures are designed for surface ceiling mounting and suitable for residential, store and office application. They are manufactured by McCulloch Manufacturing Co., Marietta, Ga. . . . Photo-switch Incorporated, Cambridge, Mass., has developed an electronic timer Series 30 designed for machinery and process control.

A new standardized transformer especially designed for oil burner ignition systems has been announced by the Specialty Transformer Divisions of the General Electric Company, Schenectady, N. Y. . . . An all plastic commercial fluorescent louver, named "Arrowhead", has been announced by Holdenline Co., Cleveland, Ohio. . . . A multiple channel photoelectric counting system has been developed by the Potter Instrument Company, Inc. Flushing, N. Y. . . . Nylon and Styron insulator bushings and sleeves are being manufactured by American Molded Products Company, Chicago, Ill.

Combustion Control Corporation, Cambridge, Mass. introduced the photoelectric scanner type 45PH5 for flame failure protection on oil burners. . . . High voltage heavy duty test leads for television measurements are manufactured by Reiner Electronics Company, New York, N. Y. . . . A nailpuller, 12 inches long, can be carried in pocket and used where ordinary bar pullers are too big and awkward to manage,

NEW EQUIPMENT BRIEFS

[FROM PAGE 190]

has been announced by K-D Manufacturing Co., Lancaster, Pa.

The Safety Center, Chicago, has announced a new "Supersite" magnifier for general industrial and commercial use. It is designed with an 8 inch lens and a large work space. . . . A new, portable projection lightmeter which flashes light measurements on a screen for easy reading by large audiences, has been announced by the Meter and Instrument division of the General Electric Company, Schenectady, N. Y. . . . A new manual reset thermal timer has been added to the Ulanet line of electric heat control products. It is manufactured by George Ulanet Company, Newark, New Jersey.

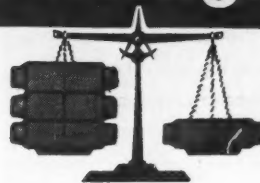
A new lightweight portable pneumatic Hypress for indenting smaller sizes of Hylugs and Hylinks can now be obtained from the Burndy Engineering Company, New York City. . . . Cutler-Hammer, Inc., Milwaukee, Wis., announces the development of a new brake shoe with "clamp-on" type lining for their line of Type M magnetic brakes for mill and heavy duty service. . . . Yellow electrical cable which can be seen plainly in the darkness of a coal mine has been developed by United States Rubber Company, New York City.

A new heavy duty, rear connected, multipole d-c magnet operated relay has been announced by Westinghouse Electric Corp., Pittsburgh, Pa. Designated the AYB, it is available in 4, 6, 7, 8, 10, 12 or 14 pole combinations. . . . A newly improved capacitor-start induction run type motor is being produced by the Brown-Brockmeyer Co., Dayton, Ohio. It is available in $\frac{1}{4}$ through $1\frac{1}{2}$ hp., 115/230 double voltage, 60 cycle, single phase, 1725 rpm. . . . "Hurseal" electrically operated, oil loaded sealed radiators are being distributed in the United States by Atlantic Electric Meter Co., New York, N. Y.

General Electric Company, Schenectady, N. Y. has announced a new photoelectric recording wattmeter designed for such applications as analyzing welding circuits and measuring industrial heating load, motor starting load, and power surge. . . . Ward Leonard Electric Co., Mount Vernon, N. Y. announces the development of their Bulletin 362 motor driven time delay relay with composite connections. . . . New indoor window hanging luminous tube transformers have been announced by the Jefferson Electric Company of Bellwood, Ill. . . . A complete line of thermocouple wire for measurement of temperatures in industrial processes and laboratories has been added to General Electric Company's line of measuring instruments.

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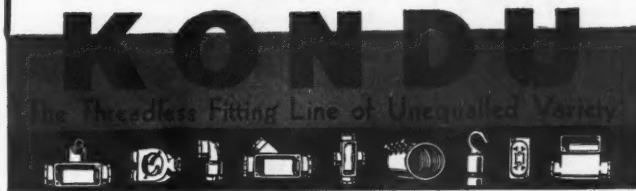
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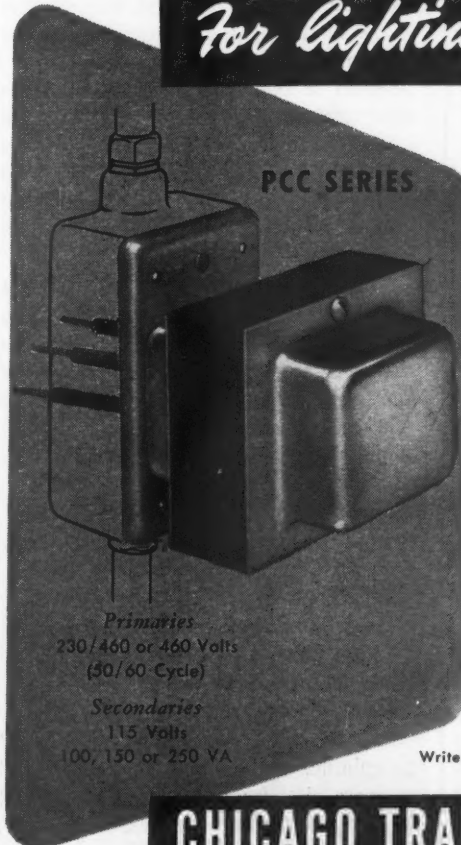
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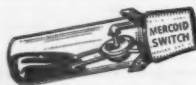
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HOSPITAL SIGNAL SYSTEMS

[FROM PAGE 83]

near the main entrance of the building or in the doctors' cloak or lounge rooms. Another unit known as the office register having the same capacity, is located near the switchboard operator. In the standard type system the office register does not require switches, but in the recall or message type, a switch adjoins each lamp designation, the same as for the entrance register.

In the standard type system the doctor operates the switch alongside of his name and this causes the lamp to illuminate his name at the entrance register and at the office register. In the message signal type the operation of the switch in the office register causes the connected lamp to flash in both units and means that such a person is wanted at the office to obtain a message, instruction, mail. A typical In and Out unit is shown in Figure 4.

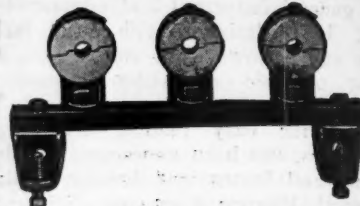
An emergency feature may be added to any Nurses' Call system. This feature is in most cases used by the nurse. It enables her to call assistance to a patient's room when the occasion requires. In the case of a locking button nurses call system the emergency call consists of a stationary button, mounted into the wall plate, and having the same mechanism as for the portable button. When such a button is depressed it operates separate and distinct signals which are added to the standard nurses call signals. As an example, a red or green lamp is added to the corridor lamp station and to all supervisory stations. In addition a bell is used as the audible signal.

Intern Call systems generally consist of either a return call system or a master telephone system between the internes living quarters and the head nurse and/or superintendent's office. In the return call system a pushbutton board with a buzzer is located at the central point and a return call station consisting of a buzzer and a pushbutton is located in each internes quarters. Added features would be drops for each interne's room at the pushbutton board and an indicating drop in the room stations. These additional features assure of any call being received. This type of a system is usually used to call internes to the nearest telephone. A handpiece may be added to any of these units to insure direct conversation and to increase efficiency.

Ambulance calls may be kept separate but are usually combined on an annunciator with other door signals.

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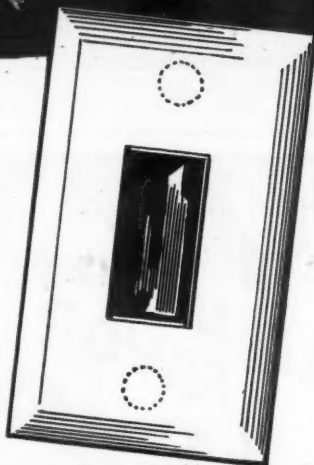
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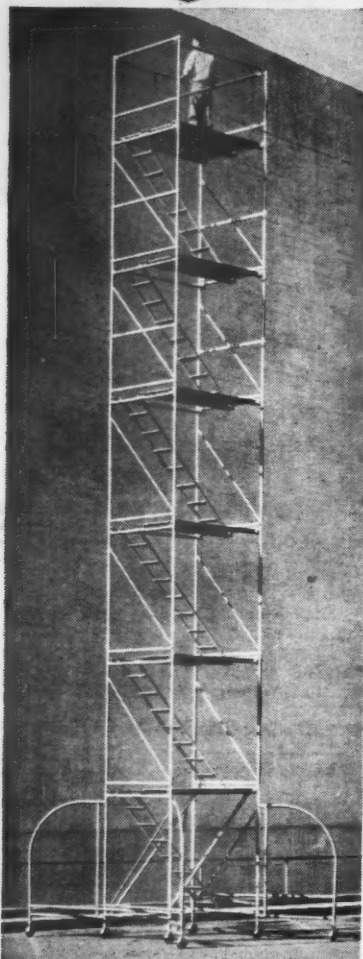
So be safe—get the Knopp Voltage Tester. It is preferred by engineers, electricians, utilities, contractors and maintenance men the nation over. Here is the voltage tester you can rely upon, backed by the 21 years experience of the Electrical Facilities Inc., technical electrical-equipment manufacturers of wide reputation. So don't kid yourself when testing. Play safe—know immediately if the circuit is open or closed and its true characteristics, by using the reliable Knopp Voltage Tester with its valuable safety features.

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In most cases however, it is so arranged that a bell operates with the annunciator indicator as a distinctive signal when a pushbutton is operated from the ambulance entrance.

Clinic systems are generally composed of annunciator or buzzer call systems. In the case of examination and dressing rooms a pushbutton plate is located in the former having a pushbutton for each dressing room. A buzzer would be located in each dressing room. The signal designates that the doctor is waiting for a specific patient. In the case of examination room, dressing rooms, and nurses' stations, pushbuttons may be placed in the rooms while the annunciator may be located at the nurse's station. A call from the examination room would designate the available rooms. A call from the dressing room would designate the person ready for examination.

Interphones

Interphones are used between the main kitchen and the floor diet kitchens and may also be used between the offices nurses' stations, supervisors, etc. In the former a master system may be used wherein the master telephone may be located in the main kitchen with a pushbutton for each outlying telephone. The outlying telephones are provided with a single pushbutton. In this system the master telephone can call any of the outlying telephones but the outlying telephones can only call the master. For intercommunication between offices and various departments it is best to use a selective-ringing-selective-talking system, so that one or all instruments may be used at one time, if required.

Nurses' home call systems are composed of the same equipment as previously described under internes call systems.

Clock systems are very important in hospitals—both for keeping time and in administering anesthesia. In general there are three different types of systems; minute impulse, combination synchronous motored and minute impulse and synchronous motored. The minute impulse system consists of a master clock which transmits electrical impulses each minute to all outlying secondary clocks. The combination synchronous motored and minute impulse system consists of a master clock which is synchronous motored but it transmits electrical impulses to the secondary clocks each minute as described in the first system. Finally, the synchronous motored system consists of a number of clocks having

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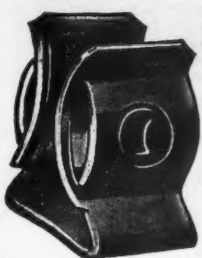
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Everything you should know about the maintenance and repair of electric motors is described in easy-to-understand language in this expertly-written book. You will find it invaluable for ready reference on the job. The author describes in full detail the procedures to follow in inspecting each type of motor. He discusses the construction of each motor, the methods used to test it, and the tools to use. He also covers cleaning and drying of motors.

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single or double synchronous motored movements connected across the line or a system having a clock master which controls all outlying synchronous motored clocks. All of these systems may be provided with hourly supervision to insure correct time.

Second beat clocks should be installed in operating rooms so that accurate timing may be provided for administering anesthesia.

Dining room call systems consist of a series of pushbuttons distributed throughout the dining room of doctors, nurses and other members of the staff, with annunciators located in the kitchen or dietician's office. The annunciator indicates the origin of the call.

Laboratory signal systems are used for various purposes. Contacts may be placed on the doors of cabinets which contain drugs, narcotics, etc., and the signals may be transmitted to an annunciator located in the office of the person-in-charge. An interlocking door control system may be provided on the doors leading to the dark room for the development of X-ray films. This is so arranged that no one may enter such a room unless an inner door is closed to insure that bright light does not enter the developing room. This system consists chiefly of electric door locks, pushbuttons and door contacts.

Door call systems are of the standard type providing pushbuttons at the front, side, rear and boiler room doors and operating an annunciator in the office with an arrangement to also operate extension bells in the event the attendant may move from one point to another.

Elevator signals for passenger, freight and dumb waiters are always provided. These are usually supplied by the manufacturers of such devices.

Alarms

Psychopathic alarm systems are used as a protection in the event a nurse or attendant is attacked by a violent patient. Such a system consists of corridor control stations, room calling stations, corridor lamps and supervisory station, as for the regular nurses' call system. When the attendant enters a room, the corridor control station is set by means of a key. This immediately energizes the room stations within that room and lights a clear lamp in the corridor door lamp stations and at supervisory points. Should it become necessary to call for assistance, the room stations are operated by means of a button which lights colored lamps at all points described previously and operates a bell at the nurses' stations.

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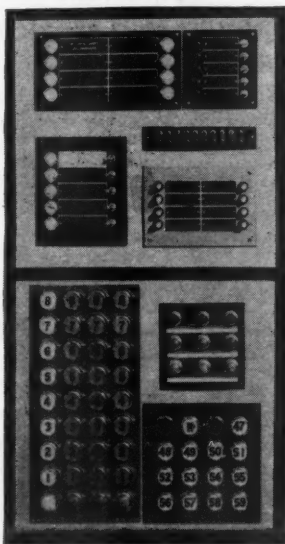
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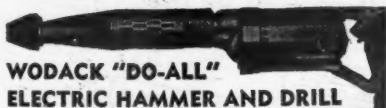
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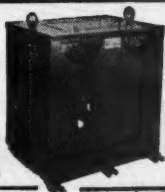
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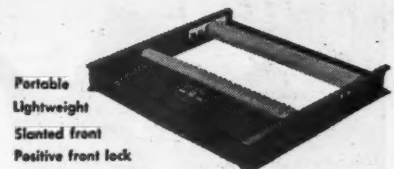
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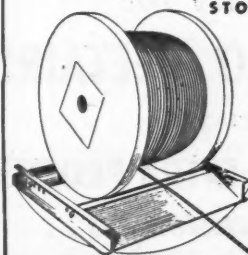
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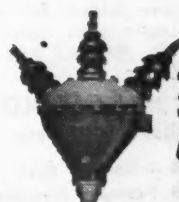
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